American Machinist

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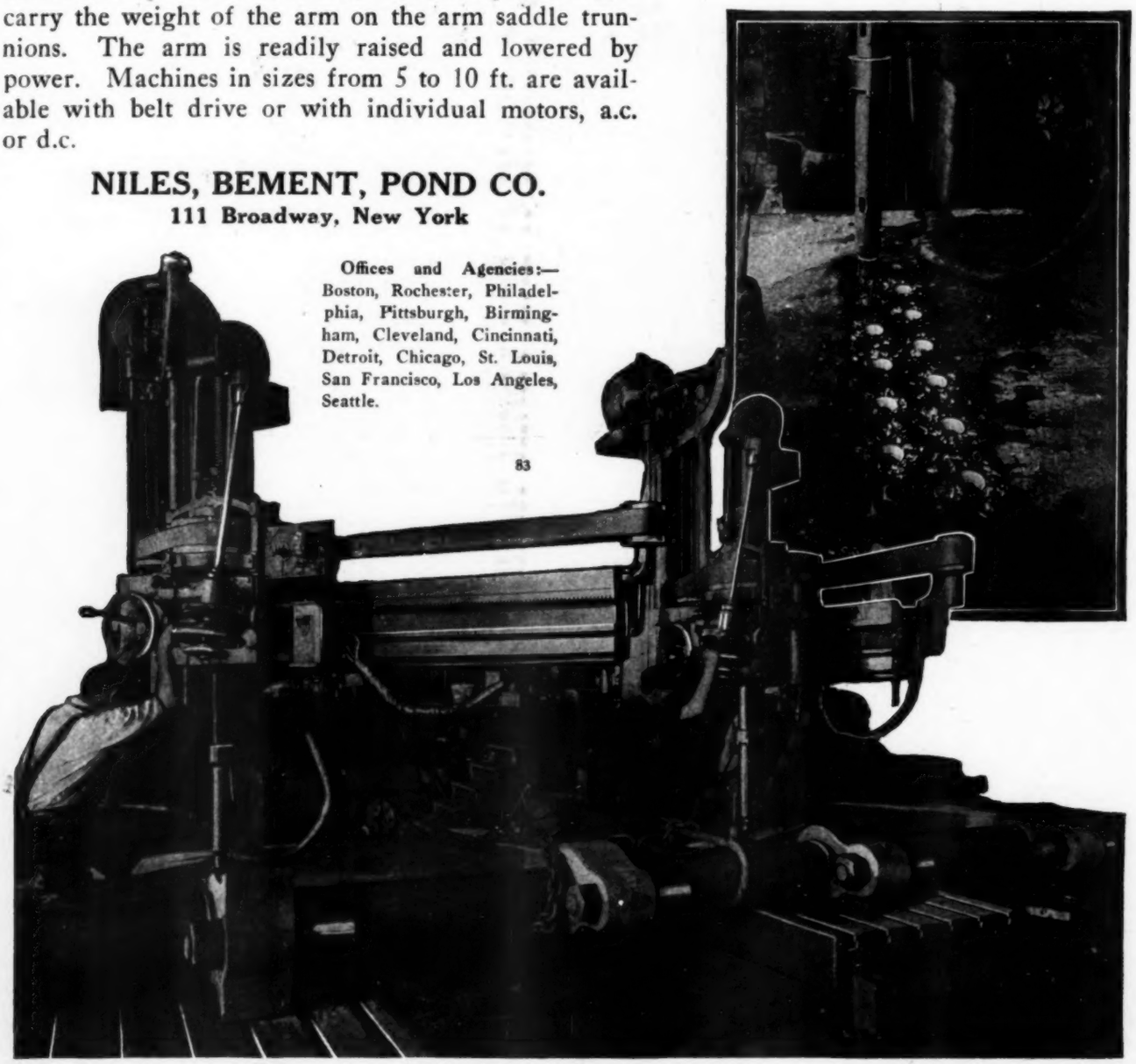

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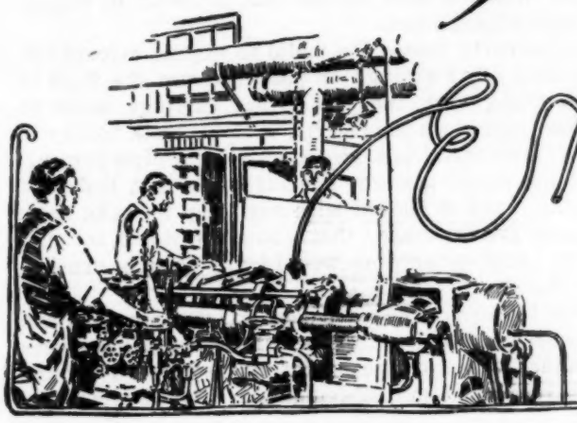


The Extrusion of LEAD PIPE

By
Ellsworth Sheldon
ASSOCIATE EDITOR, AMERICAN MACHINIST

While the extrusion of the softer metals is by no means a new process, it is one that is comparatively little known to mechanics who have not come in direct contact with it. The simple, though powerful, machinery used and the ease with which even the most complicated forms may be produced renders the process a fascinating one to watch.

THE FORMING of metals by forcing them, while in a plastic state, into or through dies made to the required shape has been practiced ever since Tubal Cain set up the first forge; but the high heats necessary to render the harder metals plastic, the comparatively narrow limits of temperature within which the material must be maintained in order not to destroy its homogenity, and the enormous pressures required to cause the molecules of metal to flow one upon another have until comparatively recent years kept the process almost what it was in Tubal's time.

The first forming dies were probably very crude, most likely a hollow spot in a rock served as a swage, and a near-round bar of iron as a fuller, while the metal was flowed into shape by repeated blows delivered with a round stone having a handle attached to it.

Though the tools used are vastly improved, drops and hydraulic forging presses introduced, and means of handling devised that are far beyond the dreams of the ancient smiths, the principle involved has not changed; plastic masses of metal are forced to conform to required shapes by pressure applied slowly and continuously as in hydraulic forging, or by impact as in the drop, power and steam hammer.

FIG. 1. EXTRUDING A LARGE PIPE

An evolution of hydraulic forging is the process known as extrusion in which plastic metal is forced to pass through an opening in a die and in passing to take the shape of the opening. Thus any length of any desired section may be produced from the softer metals such as lead, tin, copper, brass and bronze. The governing factors of this method are: the possession by the metal being worked of the property of cohesion, or ability to "weld," and the temperatures necessary to produce the required plasticity.

Solder wire, for instance, is regularly extruded from cold metal; that is, metal at ordinary atmospheric temperatures. Lead pipe can be, and often is, similarly produced from the cold slug, but for convenience of handling during the process and because of the lower pressures and consequent power required, it is customary to run this metal in a molten state to the ex-

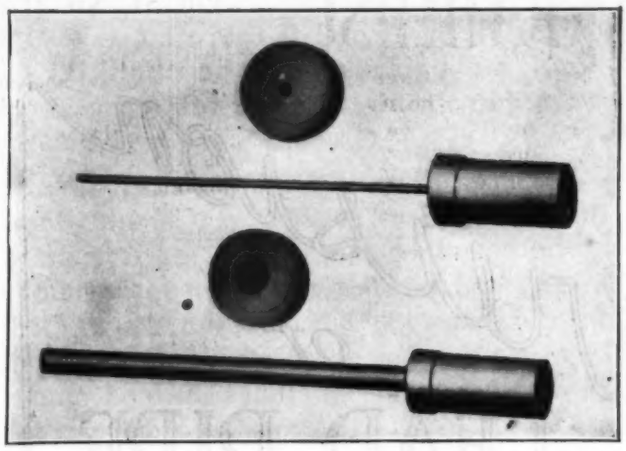


FIG. 2. DIES AND CORES

truding machinery and there allow it to "set" or cool to a temperature just below the melting point.

Extruded sections of brass and bronze are by no means uncommon in the manufacturing arts, and these metals also have to be brought to a heat just below fluidity for two reasons: it would be impractical to make dies in any but the most ordinary shapes for extruding them at ordinary temperatures; and they do not possess the welding property when cold to anything like the degree of lead or iron. Shapes that could be extruded from cold brass or bronze can be produced to better advantage by other methods.

Possibility of Extruding Iron

Iron has never been extruded, but I am assured by a prominent manufacturer of hydraulic machinery that the only obstacle in the way of its production is lack of material of which to make a die sufficiently strong to withstand the necessary pressures.

Lead, being one of the softest of metals and possessing to a marked degree the property of welding or cohering of its molecules under pressure, was probably the first to be extruded, and the manufacture of lead pipe and other shapes by this process has been in use for many years.

To the casual observer lead is lead, and it would seem that, given the machinery, all that need to be done was to run the metal into the machine and turn on the power, but to those whose work it is to form it into various shapes, lead may be an alloy of most anything in the way of metals and even contain ingredients that are not metals.

Pure lead is by no means common nor for many purposes is it desirable. Commercial lead contains traces of tin, antimony, copper and other metals, any or all of which affect its working as well as its fitness for the various purposes to which it is put. Lead alloys containing definite quantities of copper react less readily than pure lead to the ordinary acids of commerce and for this reason are used in acid making and handling machinery. Tin lowers the melting point of lead, renders it more pliable and at the same time imparts a resilience not possessed by the pure metal.

Small percentages of antimony make an alloy that is harder than pure lead, much more brittle and resistant, and one that possesses the peculiar property of expansion upon solidification.

This property causes the metal to expand strongly at the instant of "freezing" or passing from the fluid to a solid state, with the result that castings made of this alloy reproduce the pattern with absolute fidelity to detail. Type metal is a lead alloy with a high percentage of antimony, a slight amount of tin and traces of bismuth. Lead is alloyed with antimony to make large lead pipes for the reason that lead alone would not support the great weight, but would be liable to be crushed or deformed.

Silver belongs to the same chemical group as lead and is frequently found with it; in fact, there have been lead mines whose entire operating costs were covered by the silver output, leaving the lead to represent profit.

Lead Refining and Alloying

The first thing that is done with the lead when it is received at the plant is to melt it up in large kettles from which samples are taken for analysis, and the metal is thus separated according to its qualities, is reduced, refined, or alloyed to meet the necessary requirements. The work of this department partakes more of the nature of a chemical laboratory than a manufacturing plant. There is no moving machinery other than the crane to handle the heavy weights, the equipment consisting of a battery of kettles with removable covers, and the necessary ingot molds. The pigs of lead go from this department to the melting pots of pipe presses, trap machines, cable armoring

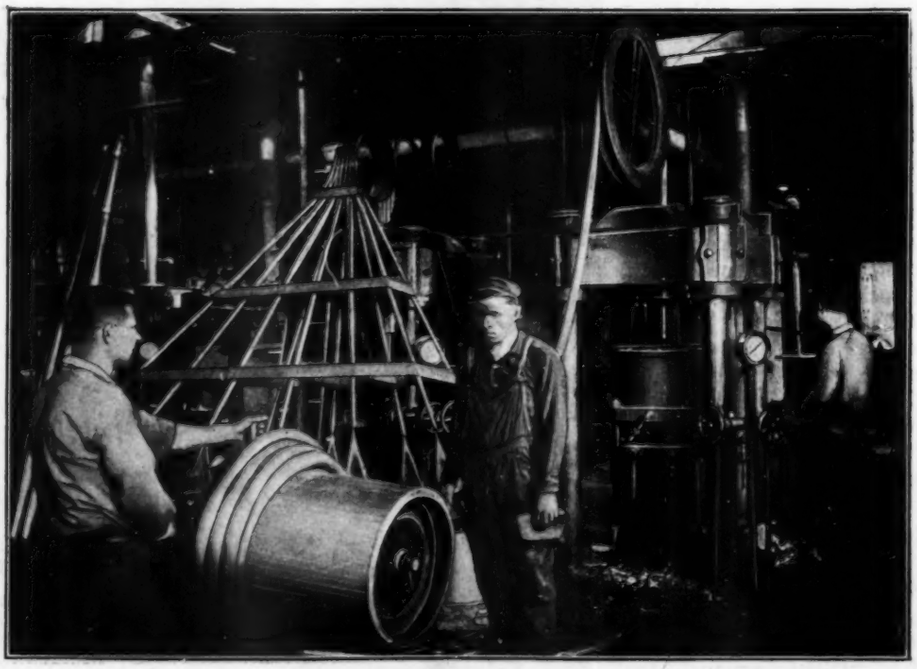


FIG. 4. EXTRUSION OF CONTINUOUS LENGTHS

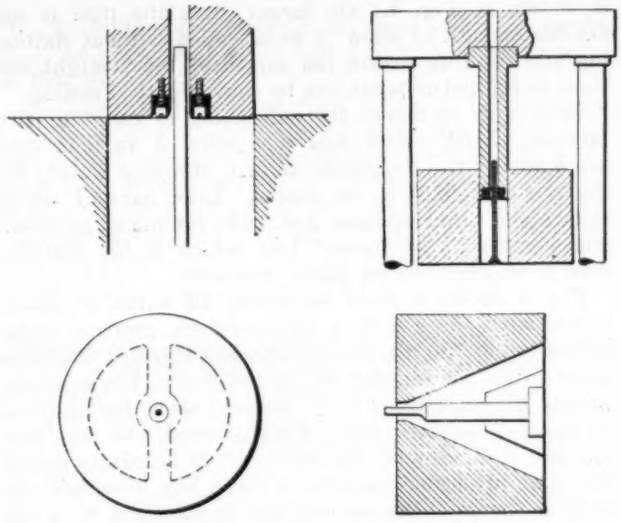


FIG. 3. SECTION OF EXTRUSION TOOLS

presses or sheet-rolling mill in accordance with the requirements of the various products.

Presses for extruding pipe are shown in Figs. 1 and 4. Fig. 1 is a vertical hydraulic press whose cylinder is sunk below the ground level, and as shown has just completed a 12-ft. length of 8-in. pipe which is ready to be cut off.

A pair of these presses is so located as to have a large melting furnace between them in which the molten lead is kept at a constant temperature and approximately at the same level. To charge a press the mold *A* is lowered to the bottom of the stroke in which position the ram *B* clears it by a matter of 3 or 4 in. These parts are so fitted that when both are hot there is practically no clearance between them and *B* fits into *A* like the piston of an engine into its cylinder.

The ram *B* is hollow and is, like the mold, interchangeable with others of varying sizes to accommodate whatever size pipe is to be made, but it is not necessary to provide a ram and mold for every size of pipe as each pair will cover a range of sizes. The die, which fastens in the lower end of the ram, is of the exact size and shape of the section to be extruded. A core which corresponds to the size and shape of the inside of the extruded piece, if that be hollow, is fastened to the bottom of the mold *A* and is long enough to extend some distance through the die, when the mold is in its lowest position.

Fig. 2 shows dies and cores for making pipe. The large end of the core fits a corresponding hole in the bottom of the mold where it is held by a taper key passing entirely through the mold. The die fits a shouldered recess in the lower end of the ram *B*, Fig. 1, and is held either by setscrews from the side or by fillister-head screws counterbored into the end of the ram.

Neither cores nor dies are ordinarily hardened; indeed many of the larger ones are of cast iron, but they must be smoothly finished and highly polished, for the reason that any inequality or roughness in either will retard the flow of metal and cause crookedness and irregularity in the product.

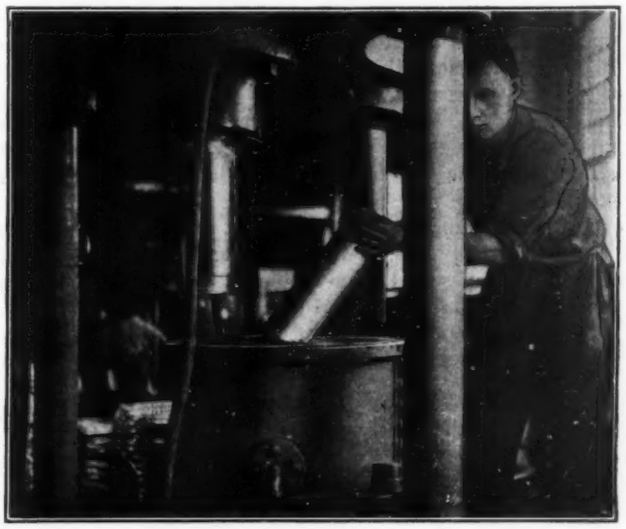


FIG. 6. LOADING THE MOLD WITH COLD SLUGS

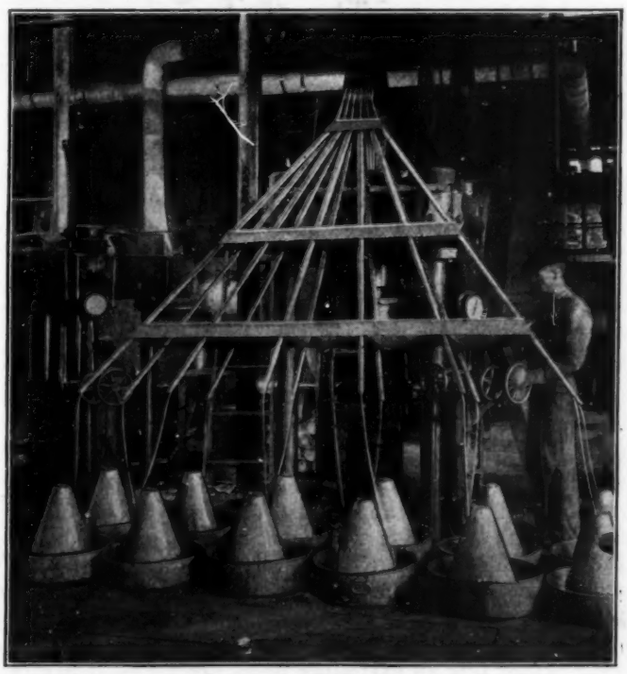


FIG. 5. EXTRUDING SOLDER WIRES

Small dies are sometimes made of tool steel and hardened, for the reason that the hardened surface is susceptible to a better finish and possesses longer life.

The diagram Fig. 3 shows the relative positions of the die and core. On very small pipes or tubes the core is so small that it would be impracticable to attach it to the bottom of the mold, and in such case it is made a part of the die. Lead tubes are drawn with an opening no larger than a cambric needle, and it is obvious that a core so small in diameter and long enough to reach the die from the bottom of the mold would soon be broken off by the friction of the flowing metal.

The Melting Kettles

The flow of metal from the kettle is regulated by a conical valve inside of the kettle and of course immersed in the molten lead. The stem of this valve extends up through the cover and has a sprocket wheel on its upper end. An operating chain runs over this sprocket and over a pair of idlers at the edge of the furnace, the bight of the chain hanging within easy reach of the press operator.

With the mold in its lowest position a short trough is hung on the spout of the kettle to conduct the molten metal into the mold, the valve opened by a pull on the

FIG. 9. LEAD SLUGS FOR SHRAPNEL

chain, and the mold allowed to fill. The filling is in accordance with the size and length of the piece to be extruded, it being desirable to have the mold exhausted at approximately the same time as a given length of pipe is completed.

While it is quite possible to produce pipe in continuous lengths by repeatedly refilling a mold and continuing the operation, there will be a joint in the pipe at the place where it was stopped in the press that will not be as good as it should be, and though this joint is not discernible to the ordinary observer it is considered advisable to have it come at a point where it can be cut out.

On the smaller sizes of pipe, 2 in. or less in diameter, the pipe passes over a large wooden wheel located on top of the press and from thence down to a reel at the floor level so that lengths of from 20 to 1000 ft. or more, according to the diameter and the thickness of wall, may be extruded from one filling of the mold. This operation

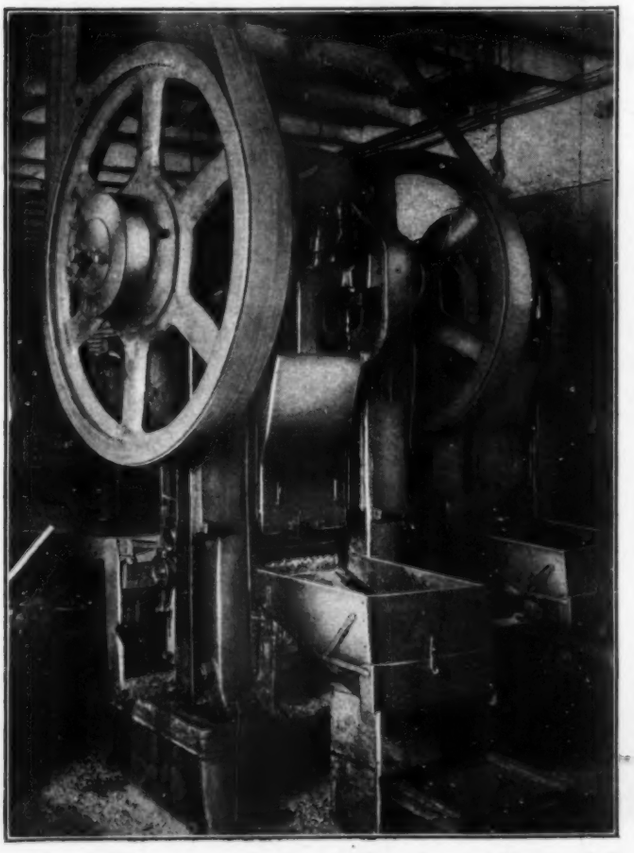


FIG. 10. FORMING SHRAPNEL BALLS

is shown in Fig. 4. On larger sizes the pipe is not flexible enough to allow it to be coiled without flattening and for this reason the length of the straight sections is limited to what can be conveniently handled.

Pipe is by no means the only thing extruded by this process. Lead, solder and fuse wire of various sizes are made by the thousands of feet, shipping weight being the only limit to its length. Lead bars of round, square and other sections are made for many purposes, and many tons of "came" lead which is the material used in making "leaded glass" windows.

Fig. 5 shows a press extruding 12 wires of solder. These wires pass over a power-driven grooved pulley at the top of the machine and thence through the tubes down to the coiling devices on the floor. These consist merely of cones made of galvanized sheet iron and set in pans of suitable size. Once started, the soft wire will coil itself around the cones for an indefinite period. The only attention required is for a boy to remove the coils as the pans become full and to start the wire coiling again.

There is, of course, no core used when extruding wire and the "charge" for the molds is a cold slug. To facilitate loading the press, the mold is made to slide

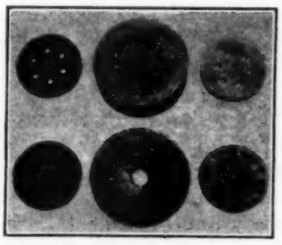


FIG. 7. WIRE AND TUBE EXTRUDING DIES

back a short distance from its normal position when the slug may easily be dropped into it. Fig. 6 shows the operation of loading.

In Fig. 7 may be seen a number of dies for different sizes of solder wire and also a die for making a special section of tube which is used in connection with chemical condensing apparatus.

Because of the much greater area of flowing metal in proportion to the size of the mold cylinder, and also because the flow is more direct—involving less molecular movement—it is practicable to extrude these sections from a cold slug of lead. It is also quite possible to extrude lead pipe of any size and section from the cold slug, but the required pressures would be much higher. A fall of 100 deg. below normal extruding temperature would require approximately 100 tons excess pressure on the ram. It is much more convenient to load the molds with molten metal especially in the larger sizes, and this also cuts out the additional operation of slug casting.

Making Shrapnel Balls

During the war many tons of shrapnel were made, the wires for which were extruded from cold slugs. Fig. 8 shows the battery of slug molds served by the movable spout swung on an apparatus resembling a jib crane. The casting operation was practically continuous until the kettle of lead was exhausted, for by the time the last mold was filled the first would be ready to dump by merely inverting it on its trunnions.

The slugs, a number of which may be seen in Fig. 9, were loaded into an extruding press exactly as shown in

Fig. 6—indeed, this same press was one of a group which was operated night and day for several months on this work.

The lead wires thus produced were fed, 12 at a time, to forming dies in ordinary punch presses where they were formed into balls by successive stages, all the wires being fed forward one step at a time until at the last stage 12 practically round balls were cut off.

As the presses ran at about 150 turns the production, 1800 balls per minute for each press, was enormous. The only other operation required to finish the ball was tumbling in rotary barrels. A shrapnel press is shown (not in operation) in Fig. 10.

The extrusion process is further used in connection with the armoring or sheathing of electric cables, and also in producing lead traps and bends used by plumbers. The lead-trap machine is unique; the facility with which the extruding pipe forms itself into bends and curves in obedience to an almost imperceptible movement of the operator's hand is fantastic.

This effect is heightened when, as in some cases, the controller is located in a darkened booth some distance from the machine, and the uninstructed observer sees the machines performing its evolutions apparently without human help or guidance.

This and other machines will be illustrated and described in a continuation of this article.

A Large Casting Finished by Grinding

By L. S. Walker

In attempting to plane the shell or body for a large magnetic chuck, it was found that the thin webs were so chilled and covered with hard scale that the tool would not stand up under the cut; moreover, there was danger of breaking the webs. As the work presented similar difficulties to the milling machine, it was decided to grind it. The illustration shows the work, which is 9 ft. x 21 in., set up on the grinding machine. Besides the removal of ½ in. of stock, it was necessary to produce a flat surface within such limits as would make a water-tight joint with the covering plate.

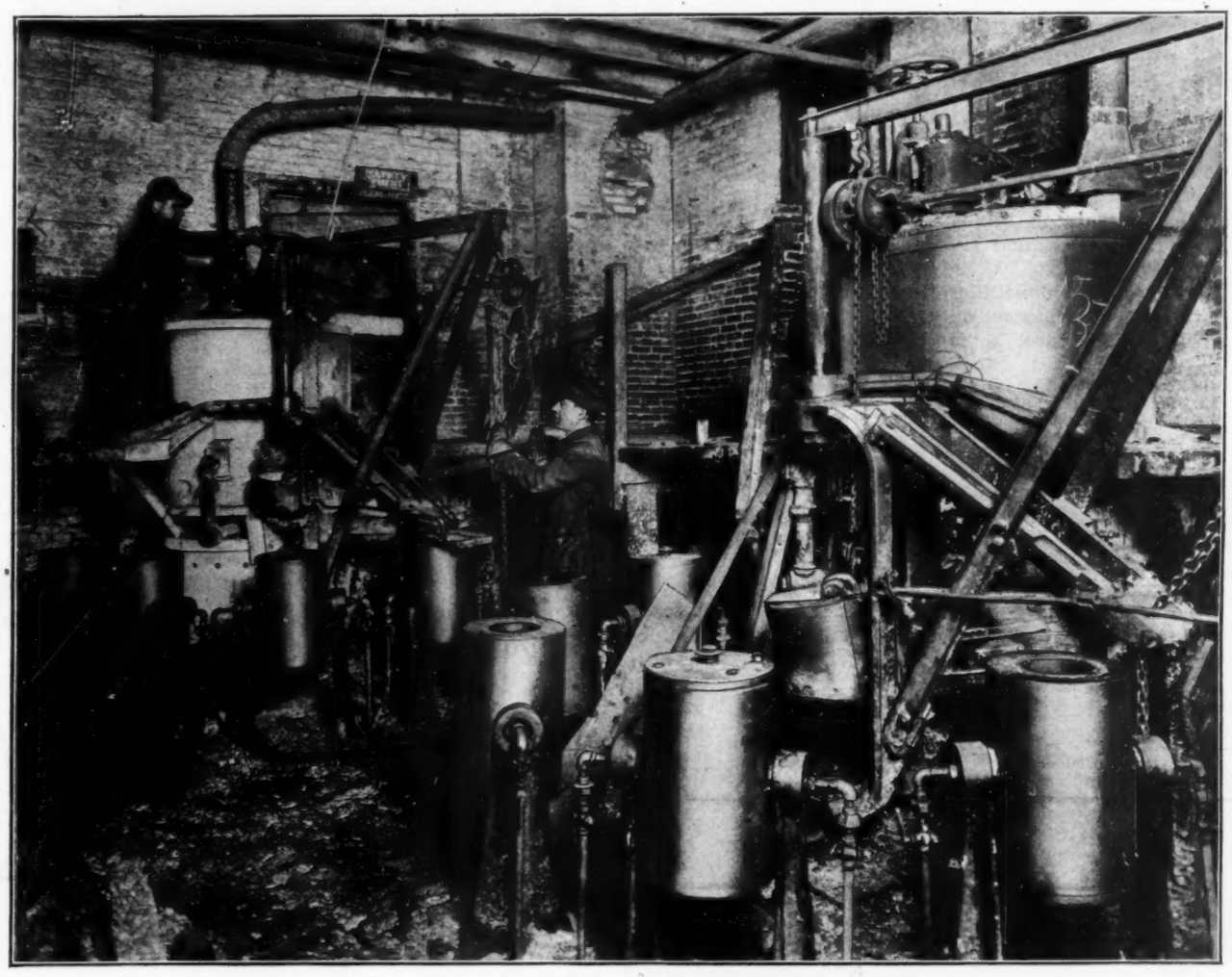
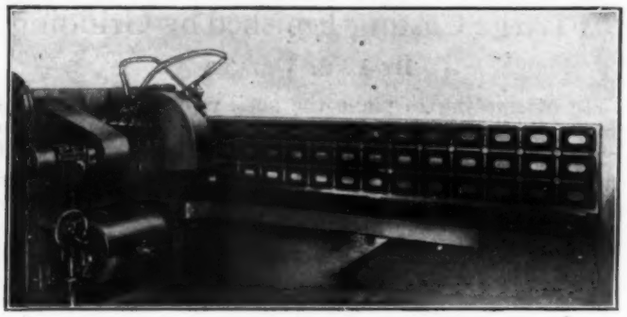


FIG. 8. CASTING SLUGS FOR SHRAPNEL

The first ⅜ in. was taken off at a rate of about ⅛ in. per hour. The remaining stock was removed less rapidly for the purpose of getting a true surface. If, originally, grinding had been figured on, instead of planing, the excess stock might have been reduced to ¼ in. or even $\frac{3}{16}$ in.; thus a considerable foundry saving could have been effected and machining time greatly reduced.

When finished, the piece was laid on a surface plate, and tissue paper about 0.0015 in. in thickness placed under the four corners, in the middle of the two ends and at several points along the sides. The only papers which could be moved were those under the middle of the



A LARGE GRINDING JOB

two ends. These could just be dragged free. This was due to the fact that the surface was slightly concaved, being caused by the manner in which the grinding wheel was presented to the work. The concavity amounted to about 0.002 in. in the height of 21 in. Otherwise the surface was perfectly flat.

A little care in taking the finishing cuts produced a surface which had the appearance of having been polished.

This job was done at the works of the Diamond Machine Co., Providence, on one of its heavy-duty, face-grinding machines.

Restoring Tool Steel Burned in Welding

BY THOMAS D. REESE

After making some experiments in welding tool steel by the oxy-acetylene welding process, using oil-tempered spring wire for welding rod, it occurred to the writer that an account of them might be of interest to the readers of the *American Machinist*.

To begin with, a streak of bad luck was encountered with two of the presses used to blank and form No. 10 can ends, breaking five tool-steel latches in rapid succession. These were replaced by those from the storeroom which was then left without any spare ones; therefore, the broken ones had to be repaired to be used until such time as a new supply could be received. The blacksmith did not care to weld these pieces, so we decided to try welding them by the oxy-acetylene process.

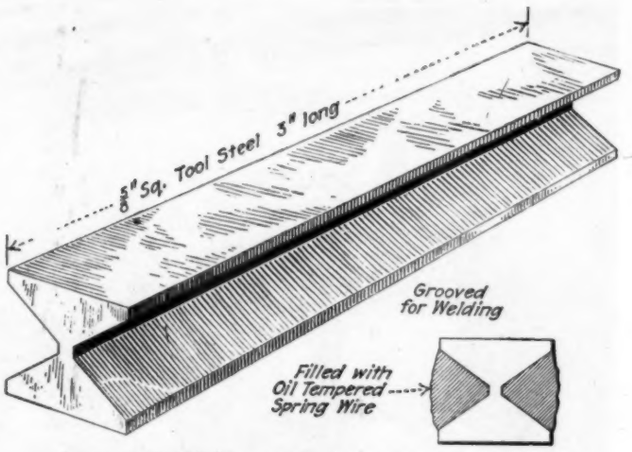
Before starting the job, however, the writer made the following experiment: A piece of Jessop's carbon steel, $\frac{5}{8}$-in. square and about 3 in. long, was placed in the vise of a shaping machine and grooved on two sides, full length, for welding, as shown by the sketch. The grooves were then filled up by welding with an oxy-acetylene torch, using oil-tempered spring wire about $\frac{3}{16}$ in. in diameter for welding rod, until the piece somewhat resembled a $\frac{5}{8}$-in. square again. After grinding the uneven surface a little, the piece was placed in the blacksmith's forge and refined by preheating, hammering and equalizing in hot oil, in accordance with the Wheeler method of heat-treating steel. The piece was then forged to $\frac{7}{16}$-in. square about 5 in. long and again refined and equalized in hot oil. One end was hardened in cold water, and while fully hard, a test piece was broken off to observe the denseness of grain to see if the steel had been fully restored to its original state of refinement.

The fracture presented such a close-grained, silky appearance that we decided to make a chisel of the piece and put it to work to test it for strength. With this chisel the writer made several heavy cuts on a piece of $\frac{1}{4}$ x 2-in. soft steel, then chipped with it on a piece of hard, flinty cast iron until his arm gave out and the experimental chisel was still going strong. All this chipping was done with the first and only grinding.

This proves conclusively Mr. Wheeler's contention that so-called burned tool steel can be restored to its original state of refinement and strength.

The above-mentioned piece of steel having been brought to a dazzling white heat, the high-carbon steel used as welding rod flowing like milk, the whole piece could be considered as burned and useless until restored by heat-treating.

The writer would hardly advise anyone to undertake the manufacture of chisels by the above method as a commercial proposition, but the same law applied to some repair jobs might prove to be very economical. After this experiment the broken latches were welded and we feel sure that they will be strong.



EXPERIMENTAL WELD ON TOOL STEEL

Figuring Diameter of Three-Surface Tangent Plug

BY FRANCIS W. SHAW

Surely Mr. Soper has gone the long way of two sides of a triangle instead of cutting across the third side. Besides, to bring in angular functions unnecessarily introduces small errors.

The formula given on page 1098, Vol. 50, for the diameter D of the plug is:

$$D = 2R = \frac{2A\ (1 + \sin \theta)}{1 + \sin \theta - \cos \theta}$$

The angle θ is known, hence, knowing also A, one may readily determine B and C. It can be shown that D, the required diameter, is equal to the periphery of the triangle bounded by ABC; that is to say:

$$D = A + B + C$$

Now

$$E = R - A \text{ and } F = R - B,$$

therefore,

$$C = E + F = R - A + R - B,$$

from which,

$$2R = E + F + A + B = A + B + C,$$

that is,

$$D = A + B + C.$$

since

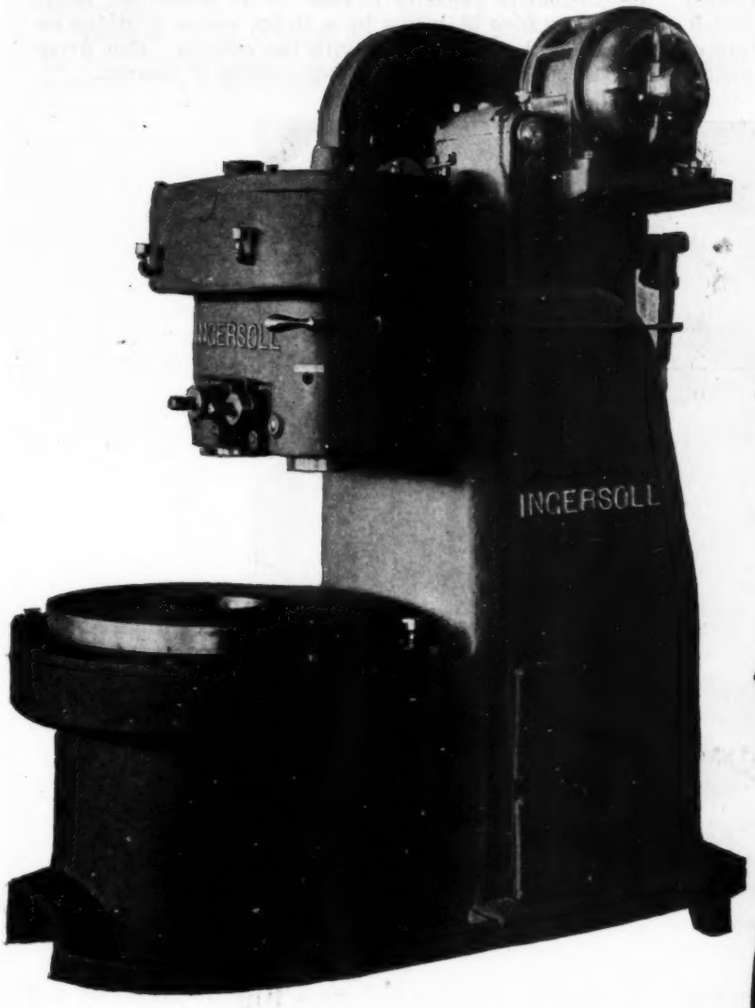
$$B = A \cot \theta \text{ and } C = A \sec \theta$$
$$D = A + A \cot \theta + A \sec \theta$$
$$= A\ (1 + \cot \theta + \sec \theta)$$

Q. E. D.

Ingersoll Circular-Table Continuous Milling Machines

By J. V. HUNTER
Western Editor, *American Machinist*

The demand for special machine tools that can aid in lowering the cost of production has never been greater than at the present time and the advent of such tools is looked upon with interest by all manufacturers. This article describes and illustrates several types of continuous milling machines that have been developed for maximum production with minimum labor.



MACHINING plain surfaces by milling has long been accepted as a cheap and rapid method, and the need for increased production has led to the development of a line of milling machines in which the loading and unloading does not interrupt the output.

The Ingersoll Milling Machine Co., Rockford, Ill., has lately brought out several types of continuous milling machines with circular tables, each one of which has been built to do specific work and no attempt has been made to adapt them to general purposes. The plan has been to analyze a certain machining problem and to build a machine best suited to take care of that particular job.

It is generally accepted as a fact that more and better work can be produced when both the roughing and the finishing cuts can be taken without resetting the work. With this in view, the machines herein described have been provided with spindles for carrying both roughing and finishing cutters.

Fig. 1 illustrates a machine of the single-station type, requiring but one operator who loads and unloads the fixtures as each one is brought to the proper station. While this is being done the work in other fixtures is passing beneath the cutters uninterruptedly.

Fig. 2 shows the construction of the machine. The spindles are driven by hardened-steel gears and run in

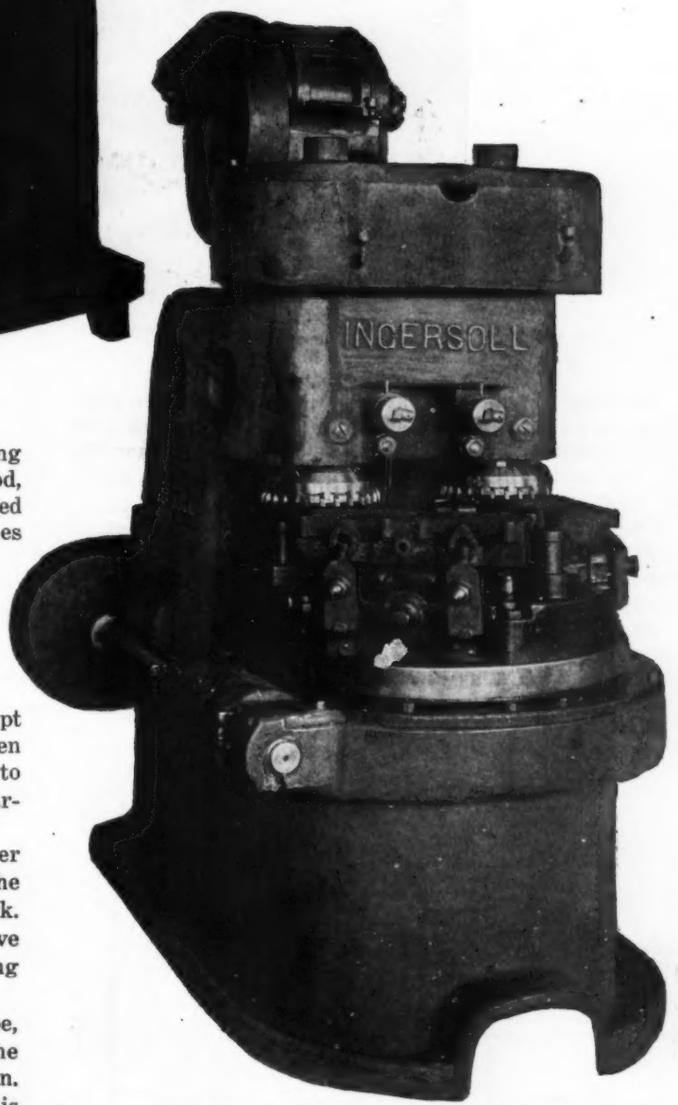


FIG. 1. SINGLE-STATION MACHINE FOR MILLING CYLINDER HEADS

Diameter of table, 30 to 84 in.; spindles, two; adjustment of spindles, 6 in.; revolutions of table, one in 4¼ min.; fixtures, three; power required (motor belt), 10 hp.; weight, 9000 lb.; floor space, 24 sq.ft.

bronze bearings that are almost as long as the spindles themselves. The bearings are contained in quills which, by means of racks and pinions, are used to take care of the necessary spindle adjustment in a vertical direction.

the productive capacity is close to 37 pieces per hour.

The machine is driven by a 10-hp. motor mounted on a bracket that is integral with the column. Belt drive may be substituted for the motor drive if desired.

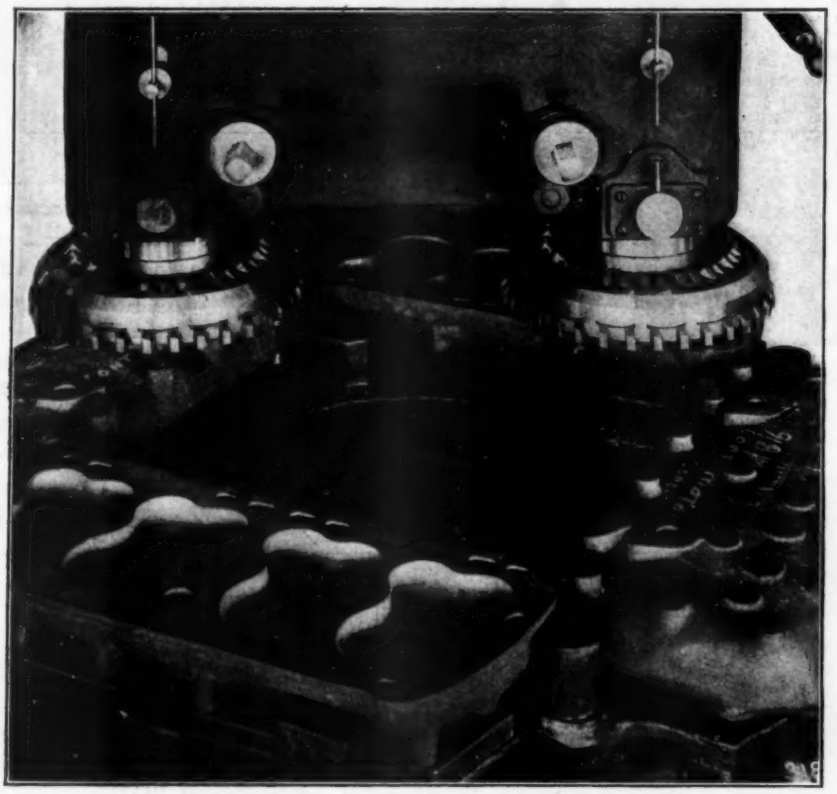


FIG. 3. CLOSE-UP VIEW SHOWING ARRANGEMENT OF WORK AND CUTTERS

Machines of this type have been built with tables from 30 in. to 84 in. in diameter, according to the work they were designed for. No limit has been fixed either for the size of the table or the height of the spindle above the table.

The table is driven by worm gearing through gears contained in the cylindrical box that can be seen extending from the upper part of the base. The wormwheel is approximately the same diameter of the table.

As shown in Fig. 1 the machine is arranged for milling cylinder heads for four-cylinder motors. There are three fixtures and as the table revolves once in 4¾ min.

Fig. 3 is a close-up view of a similar machine and shows the arrangement of the work and cutters.

A machine built for larger work is shown in Fig. 4. In this machine the table revolves about a center column which also supports the head carrying the spindles. Two cutters are used for roughing as a single cutter large enough to cover the work would impose too great a strain on its spindle.

This machine can be built either with a single station or with multiple stations as the character of the work and the requirements of the user may indicate. As illustrated it has a single station, the operator standing

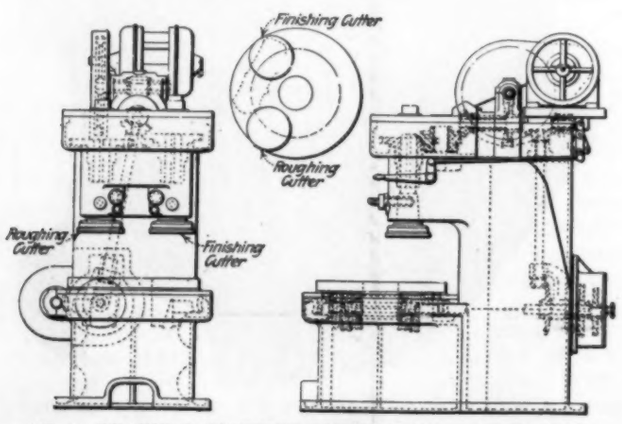


FIG. 2. DRAWING SHOWING CONSTRUCTION OF MACHINE ILLUSTRATED IN FIG. 1

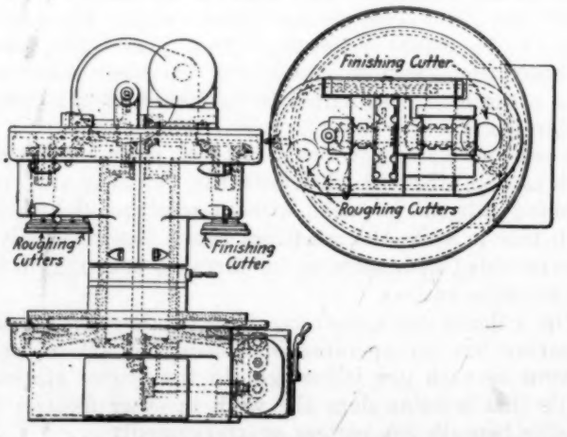


FIG. 5. DRAWING SHOWING CONSTRUCTION OF MACHINE ILLUSTRATED IN FIG. 4

before it to load and unload the fixtures as they rotate before him.

The drive is by a motor mounted on top of the spindle head through suitable reduction gearing. The table is driven by a wormwheel inclosed in the base, the worm being located in the rectangular box projecting from the circular base as shown. The table can be started or stopped by means of a clutch operated by a conveniently located lever. The spindles are carried in quills and the vertical adjustment is by racks and pinions.

The bearings in the base are oiled from a central station located on the gear housing and a similar station on the head takes care of the lubrication of the bearings in that part of the machine.

The table is 60 in. in diameter and as shown in the illustration, is equipped with five fixtures for milling cylinder blocks. It makes one revolution in 12 min. so that the productive capacity of the machine is 25 cylinder blocks per hour. The general construction is shown in Fig. 5.

A three-station machine of similar character is illustrated in Fig. 6 and arranged for milling small surfaces on the sides of cylinder blocks.

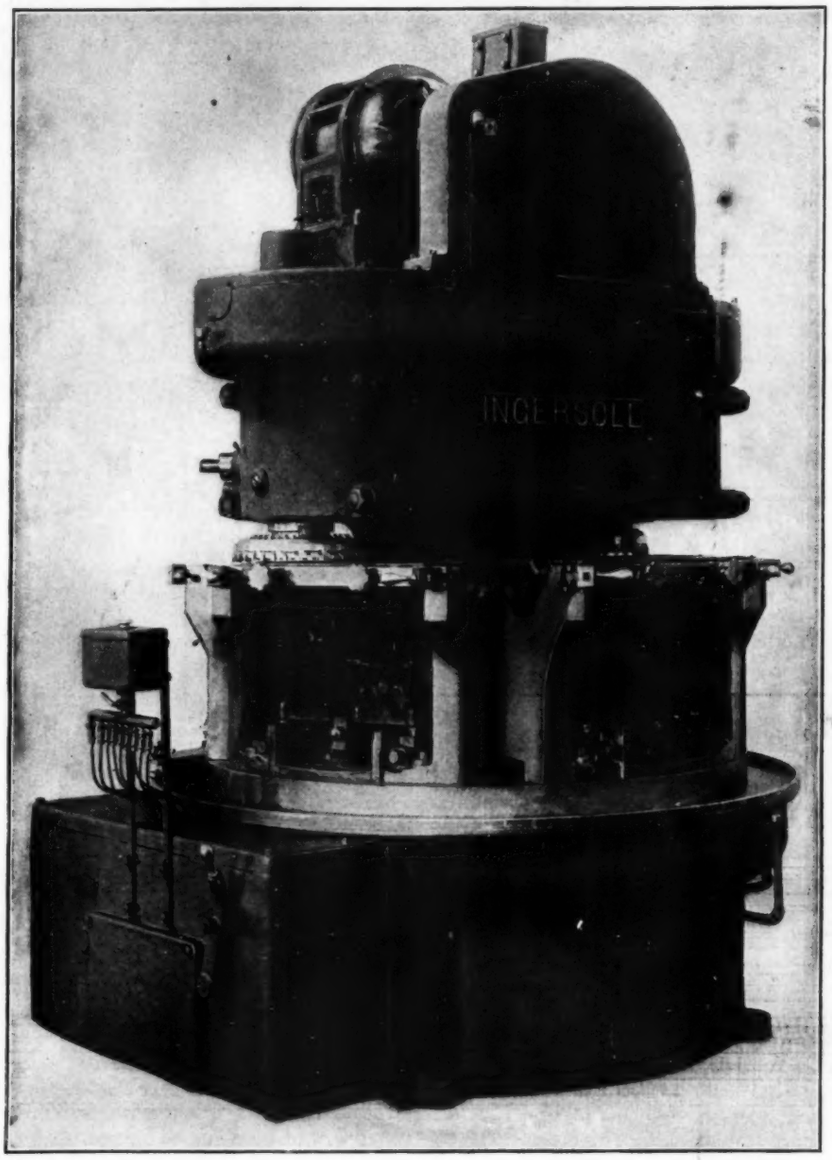


FIG. 4. SINGLE-STATION MACHINE FOR MILLING CYLINDER BLOCKS

Diameter of table, 60 in.; spindles, three; distance between table spindles, maximum 24 in., minimum 18 in.; spindle adjustments, 6 in.; revolutions of table, one in 12 min.; fixtures, five; power required, 15 hp.; weight, 24,000 lb.; floor space, 45 sq.ft.

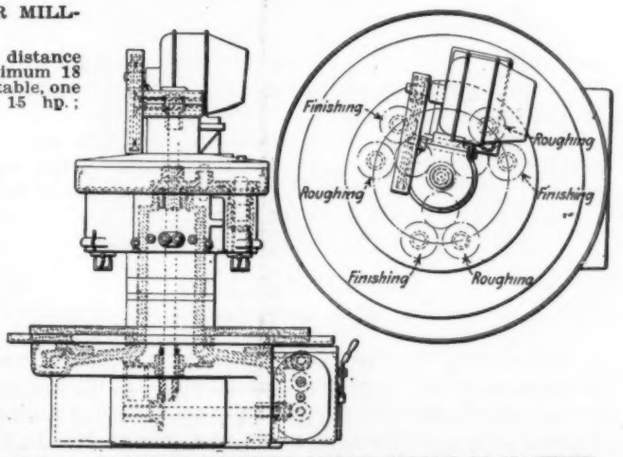


FIG. 7. DRAWING SHOWING CONSTRUCTION OF MACHINE ILLUSTRATED IN FIG. 6

This machine is provided with six spindles, three for the roughing and three for the finishing cutters.

As illustrated the table is equipped with nine fixtures and the service of three operators is required to load and unload them. The table makes one revolution in 13½ min., giving the machine a productive capacity of 120 pieces per hour.

The drives, oiling systems and adjustments are all similar to those contained in the description of the machines previously illustrated. The general layout of this machine may be seen in the drawing, Fig. 7.

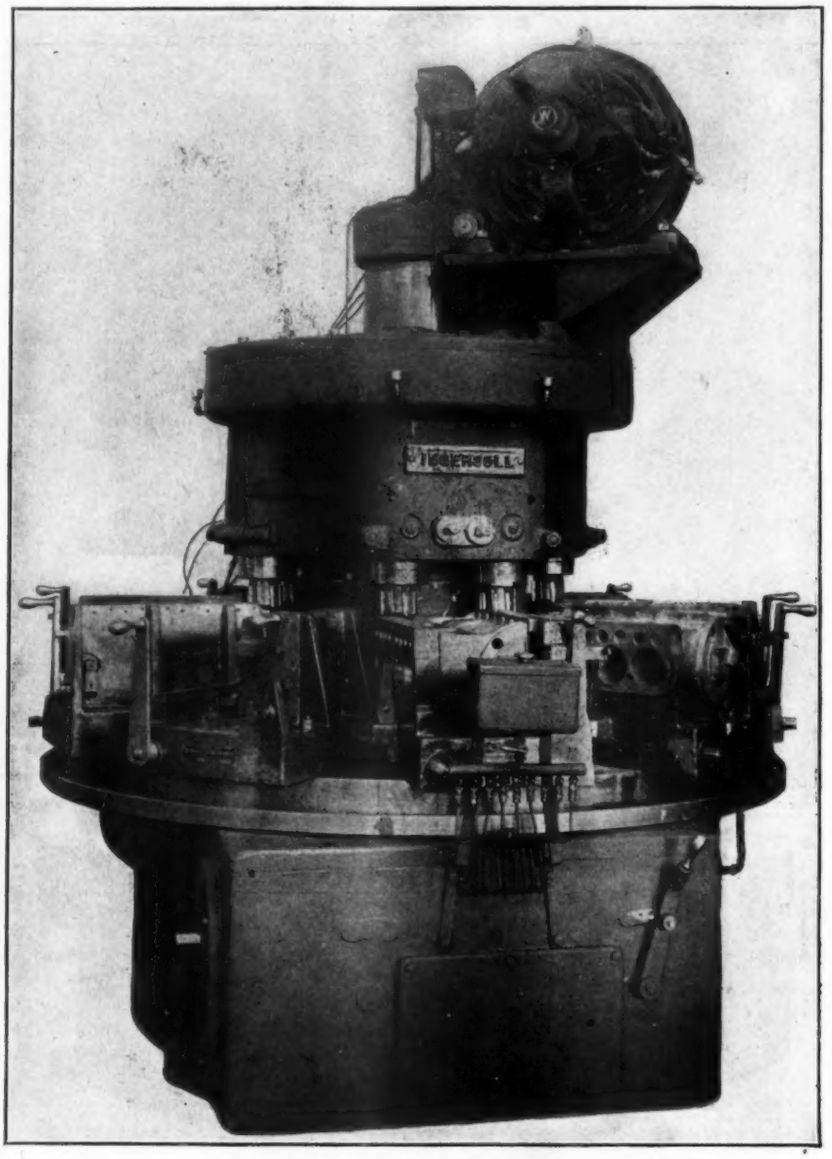


FIG. 6. THREE-STATION MACHINE

Diameter of table, 70 in.; spindles, six; distance between table and spindles, maximum 18 in.; minimum 12 in.; spindle adjustment, 6 in.; revolutions of table, one in 13½ min.; fixtures, nine; power required, 15 hp.; weight, 24,000 lb.; floor space, 45 sq.ft.

Assigning Jobs

PETER F. O'SHEA

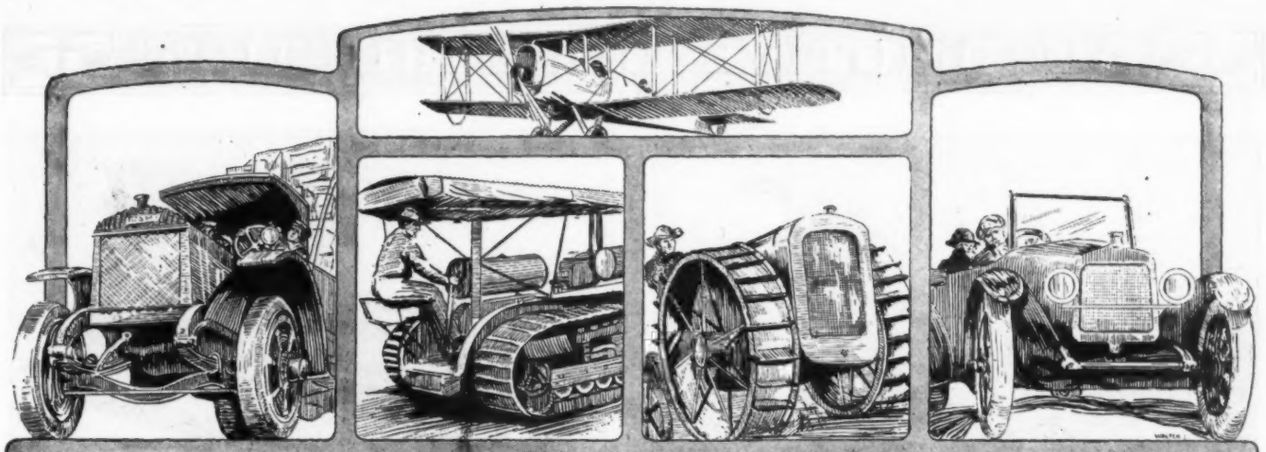
A manager of a job shop employs only skilled mechanics of whom some are specialists, but all are all-round expert mechanics. He has two rules for assigning operations on the very many new jobs that come in.

The first rule is: Give each man the sort of job that he can do better than he can do any other job. The second is: Give each job to the man who can do it better than any other man can do it.

If one of these two rules won't guide the manager to the right man, the other will. If these two things are done the highest quality of work available in the shop will be secured, and, simultaneously, every job will be done in the quickest possible time, by an expert.

Moreover, every man will be content for he is doing the kind of thing that he likes best because he can do it best. He feels that the assignment of a ticklish job to him picks him out before the shop as an expert in that work.

Being naturally desirous of vindicating the judgment of his employer in respect to his own special ability he will put forth his best endeavor to complete the job in the best possible time consistent with the nature of the work, and thus maintain his reputation.



A Rear-Axle Housing That Is Different

By FRED H. COLVIN
Principal Associate Editor, *American Machinist*

This is not only a rear-axle housing of unusual construction but the jigs and fixtures have been so designed that each one checks the work of the previous operation. The tools are simple and are especially interesting on that account.

THE rear-axle housing of the Autocar truck is of rather unusual design, being made in two pieces and so shaped in the center as to form a rectangular box which receives the combination of spur and bevel gearing used for the drive. The first operation is to straighten the steel casting so that it will clean up in machining at all points. Next comes the rough- and finish-boring, which is done in the fixture shown in Fig. 1. The housing *A* is positioned by the template *B*, which is then removed. The flanged end is clamped at *C* and located against the stop *D*. The other end is clamped at *E*, the whole fixture being mounted on the carriage of the lathe as shown. At each end of the fixture are the substantial housings *F* and *G* which guide the boring bar *H*, the cutters being put in place after the bar has been inserted in the guide bushing *I*. The large facing cutter at the left cleans the end of the bearing at the center of the housing.

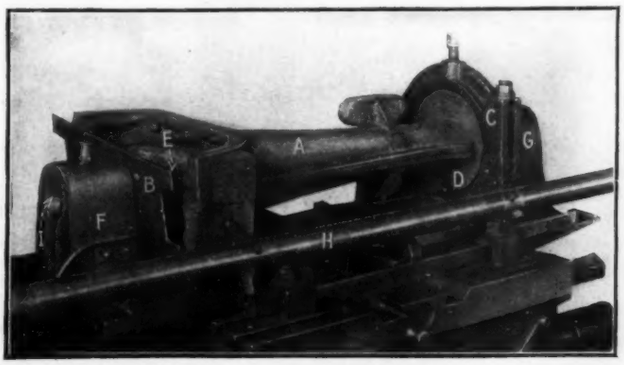


FIG. 1. BORING THE CENTRAL HOLE IN HOUSING

After the housing has been carefully bored, it is mounted on a stud of pilot *A*, as shown in Fig. 2, and the upper end reamed. The brackets *B* prevent the turning of the housing under the action of the reamer

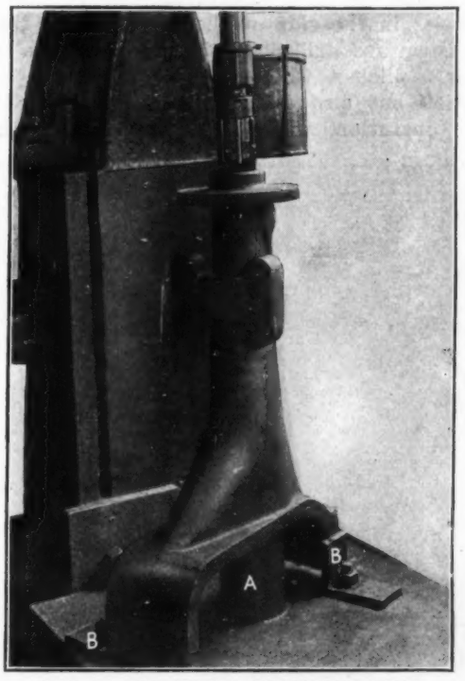


FIG. 2. REAMING THE OUTER END

and allow the housing to be easily and rapidly handled, as would not be the case with an elaborate fixture.

The housing is then mounted on a mandrel and swung in the lathe as shown in Fig. 3. Here the small end and the flange are turned and faced and at the same time the face of the large end, which makes the joint with the other half of the axle, is faced by the

AUTOMOTIVE CONSTRUCTION

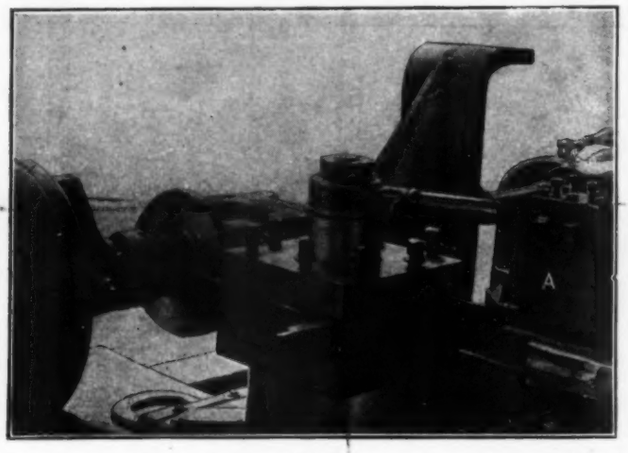


FIG. 3. TURNING THE FLANGE AND FACING BACK END

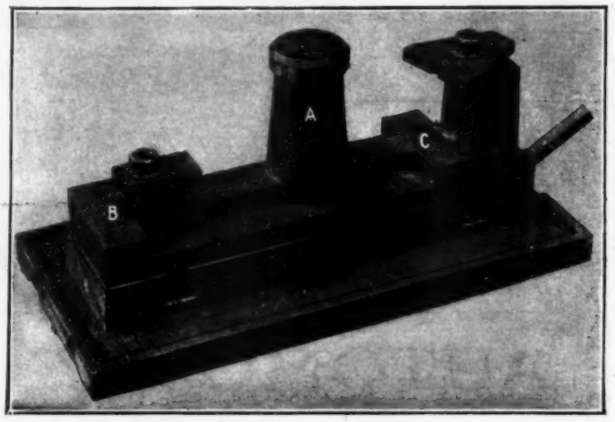


FIG. 4. FIXTURE FOR MILLING SIDES OF HOUSING

tools in the block *A*. This insures the ends of the housing being square with the bore.

The housing is then mounted on the simple, yet efficient fixture shown in Fig 4, the large hole being located on the pilot *A* and the ends of the housing which have just been faced, resting on the surfaces *B* and *C*. With the housing clamped down in this position, the sides are milled to the proper dimensions.

Next comes the milling of the pad for the spring seat, the housing being held on a fixture somewhat similar to the one just described.

The holes in the side of the large end of the rear-axle housing are drilled in the jig shown in Fig. 5. This has a pilot *A* which not only holds the housing in position but also checks the milling done in the previous operation. For, if by any chance the two sides have not been milled at the proper distance from the central hole, the housing will not go in the jig, which automatically acts as an inspection gage and rejects pieces which have been improperly milled. A C-washer is slipped over the end of the rod and enables the housing to be easily bolted into place. As will be seen, the fixture has six feet on each side and carries the bushings for the two sizes of holes.

The jig shown in Fig. 6 is for drilling the holes in the spring pad near the small end of the housing. The housing is slipped over the pilot *A* and the hook bolt *B* swung down over the flange. Then the cam *C* is rolled up until it contacts with the lower side of the axle housing and takes the load off both *A* and *B*. Then the bushing plate *D* is swung down over the pad, fastened by the wingnut shown, and the holes drilled.

Another jig for drilling the holes in the flange is

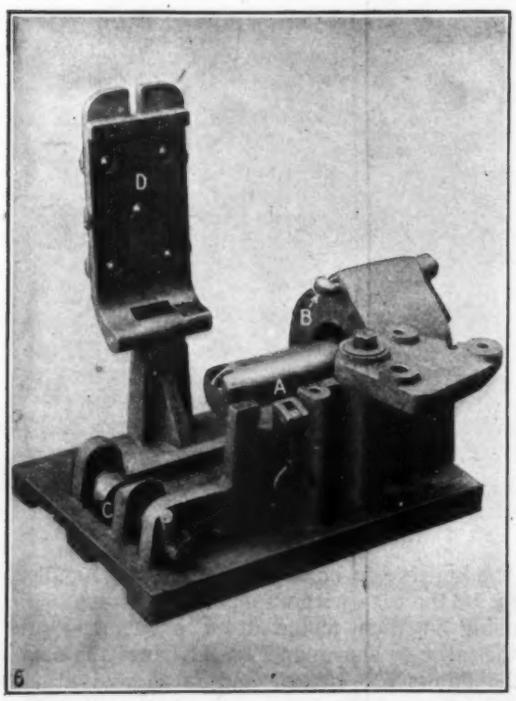


FIG. 6. FIXTURE FOR DRILLING SPRING PAD

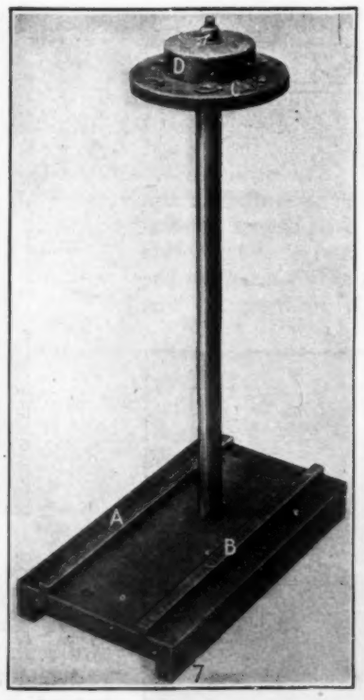


FIG. 7. DRILLING FIXTURE FOR FLANGE HOLES

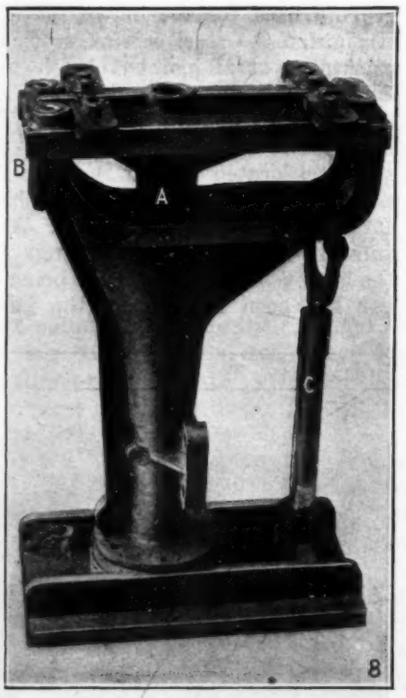


FIG. 8. FIXTURE FOR DRILLING LARGE END OF REAR-AXLE HOUSING

AUTOMOTIVE CONSTRUCTION

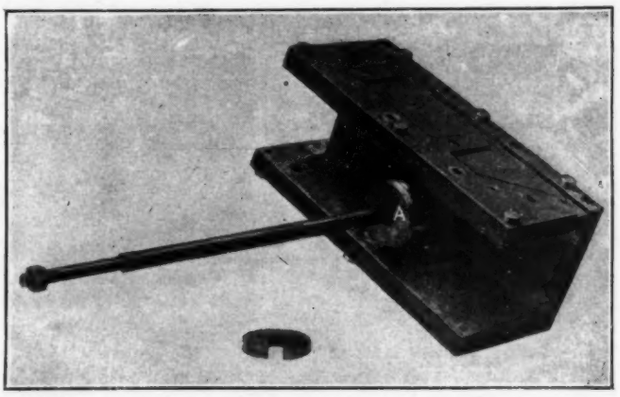


FIG. 5. DRILLING FIXTURE FOR HOUSING SIDES

shown in Fig. 7. The open rod of the housing rests on the strips *A* and *B*, while the bushing plate *C* is held in position by the nut *D*.

The holes for the bolts which hold the two halves of the housing together are drilled in the jig shown in Fig. 8. This consists of two parts: the base, which receives and supports the outer end of the housing, and the bushing plate, which fits over the large end. This bushing plate carries the pilot *A*, which fits into the hole in the housing and which also has projecting sides as at *B*, which fit over the milled surfaces of the housing and locate the bushing plate with relation to the center line of the axle. The support *C*, with the yoke at its upper end, is held to the housing by capscrews and takes the thrust of the drill on the overhanging end of the yoke.

It will be noted that these jigs and fixtures are exceedingly simple and that they are so designed that in most cases each tool checks the accuracy of the work done in previous operations; for if these are not done correctly, the pieces will not fit the tools for subsequent operations.

Bending Motor Piping

By I. B. Rich

In common with most automotive motors, the one used by the Autocar Co. requires considerable pipe bending. This can easily be not only an expensive, but also a very tiresome and mussy job. The apparatus which has been provided, however, even though it might be called crude in some cases, has much to commend it from the standpoint of simplicity and effectiveness.

The melting of resin for filling pipes before bending is usually more or less annoying, but the furnace shown in Fig. 1 makes it a comparatively easy task, as well as one which is free from fire risks. This was rigged up in the shop and consists primarily of a steel-plate housing which holds the resin to be melted. Inside the tank is a ½-in live-steam coil which heats the back, bottom and front, while a ¼-in. pipe runs to a copper coil around the spigot or faucet to prevent resin hardening at the outlet. The resin to be melted is placed in hand hole *A* at the top and is drawn off at the outlet *B*, as wanted.

The melted resin is drawn out in a small pail provided with a spout and poured into the pipes to be bent, a plug of wood closing the lower end. After the pipes are properly filled they are taken to the bending bench shown in Fig. 2. Five different bending forms are shown, but this by no means completes the list, a form being left permanently in place for each bend required. The resin-filled tube is placed in position over the bending block *A*, the lever *B* which carries a substantial roller in its forked end is raised to its

FIGS. 1 AND 2. TANK AND TORCH FOR MELTING RESIN AND THE FORMS USED FOR BENDING

AUTOMOTIVE CONSTRUCTION

upper position, the block *C* which has a half-round groove the size of the pipe to be bent, is placed in the position shown, and the lever brought down by hand, giving the desired bend to the pipe.

When the pipe has been properly bent it is taken back to the furnace, the Bunsen burner lighted and the pipe held in the tongs shown, so that the resin is readily melted out and runs into the pan *C*, Fig 1.

Time-Saving Boring-Mill Fixtures for Truck Steering Knuckles

SPECIAL CORRESPONDENCE

The illustrations show two special boring-mill fixtures by which difficult jobs are being easily handled in the plant of the Pierce-Arrow Co., Buffalo, N. Y. Fig. 1 shows the fixture and chucks used for holding the heavy truck steering knuckles during the boring operation. The knuckle is located both by its stub-axle and the boss at the other end, the stub being both centered and held by means of the simple swinging clamp shown at *A*. This not only allows quick adjustment but also has three hardened-steel bearing plates which readily locate the end of the axle, and also hold it firmly in place. The other end is adjusted and held by a pair of heavy setscrews, one of these being shown at *B*.

The most unusual feature of this fixture, however, is the way the three centering jaws, *C*, *D* and *E* are backed up by the ring *F*. After the forging has been put in place, the ring *F* is slipped over the upper end of the jaws and the setscrews *G* tightened, forcing the jaws directly against the work and supporting them so as to avoid spring and to relieve any tendency to loosen their grip on the work.

Another interesting fixture is shown in Fig. 2. This

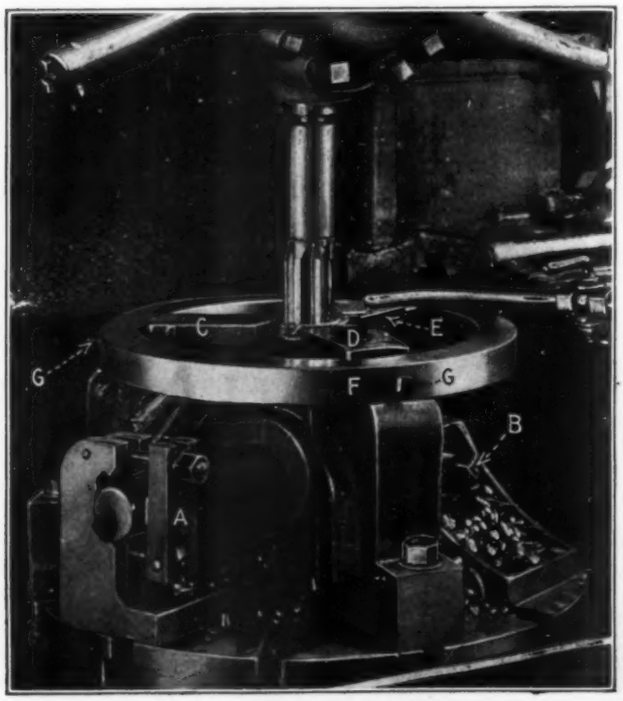


FIG. 1. RING FOR SUPPORTING CHUCK JAWS

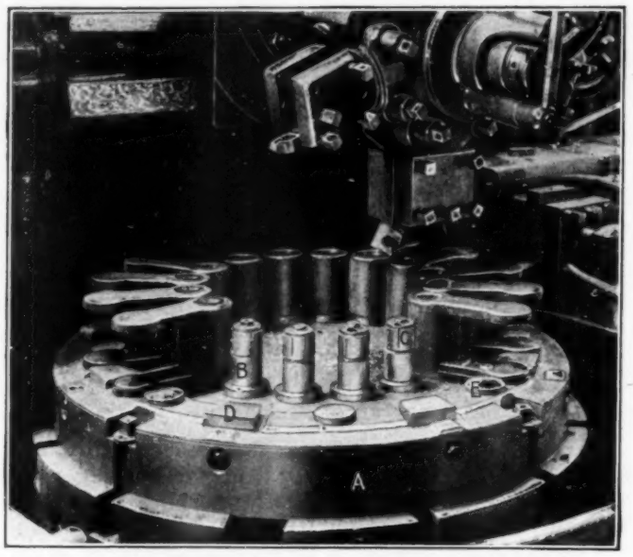


FIG. 2. FIXTURE FOR FACING SPRING SHACKLES

holds 16 spring shackles while they are being faced, both outside and in. It is a comparatively simple fixture, the round base *A* being mounted directly on the regular boring-mill table. The shackles are simply slipped over the studs shown at *B*, each stud being provided with an expanding bushing *C* on its upper end, which effectually holds the shackle against lifting. The wedges *D* and *E* take care of the thrust of the cutting tool, the wedge-shaped shoes *D* holding the shackles firmly in position. The bushings are controlled by the flanged-head bolts, these being handled by a suitable socket wrench. This fixture allows the work to be rapidly and accurately handled. Details of this fixture are shown in Fig. 3, reference letters being the same as in Fig. 2.

Both of these devices can be readily modified to fit many other conditions and are full of suggestions for many different classes of work.

The steel, bowl-shaped casting which houses the differential on the Pierce truck is being machined on a Bullard vertical turret lathe in Fig. 4. This is a com-

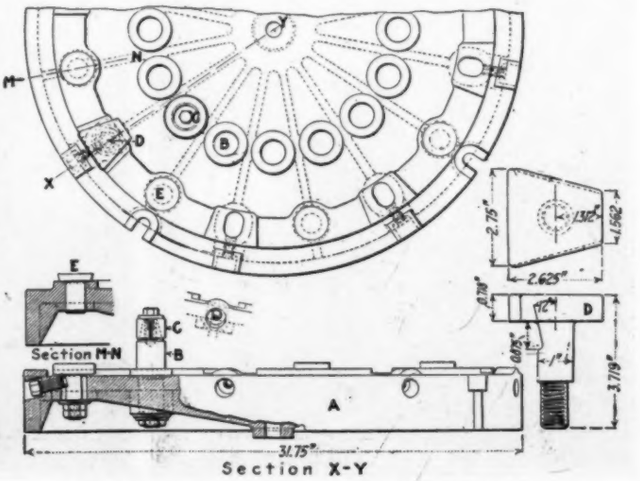


FIG. 3. DETAILS OF BORING-MILL FIXTURE

AUTOMOTIVE CONSTRUCTION

paratively simple operation, the housing being centered by the flange on each end resting on the adjustable V-blocks *A* and *B*. This allows either end to be raised so as to level up the face of the housing in order to clean up to the best advantage.

The actual holding of the work is done by the straps

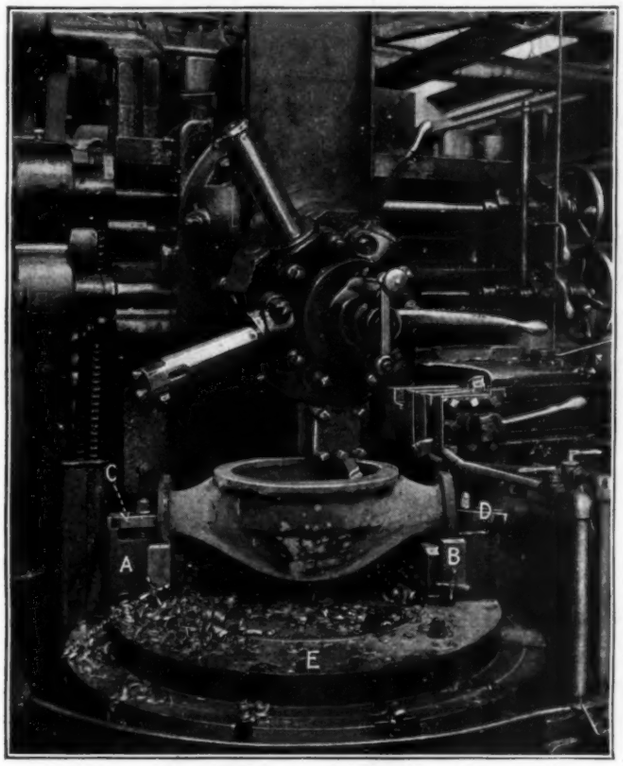


FIG. 4. BORING TRUCK DIFFERENTIAL HOUSING

C and *D* which form part of the fixture *E*, mounted on the regular table of the boring mill.

Three tools are used in the turret, while the tools in the side head simply face off the under surface of the flange and turn the outside. The casting is of steel, as indicated by the chips on the fixture and table.

Two Winton Milling Fixtures Used on Motor Parts

BY FRANK C. HUDSON

The milling fixture, shown in Fig. 1, is in use at the shop of the Winton Motor Car Co., Cleveland, Ohio, and shows an ingenious clamping device for milling connecting-rods. This fixture handles the connecting-rods in pairs, with the ends reversed, and each end supported in the special V-blocks shown.

The clamps are triangular in shape, each having one end notched to fit over the bolt boss on the large end of the connecting-rod. Three of the clamping points are shown at *A*, *B* and *C*, the fourth point, which holds the large end of the other rod, being hidden by the rest of the fixture. Both of the clamps are held in place by the central stud, the nut *E* determining the maximum distance between the upper side of the clamp and the

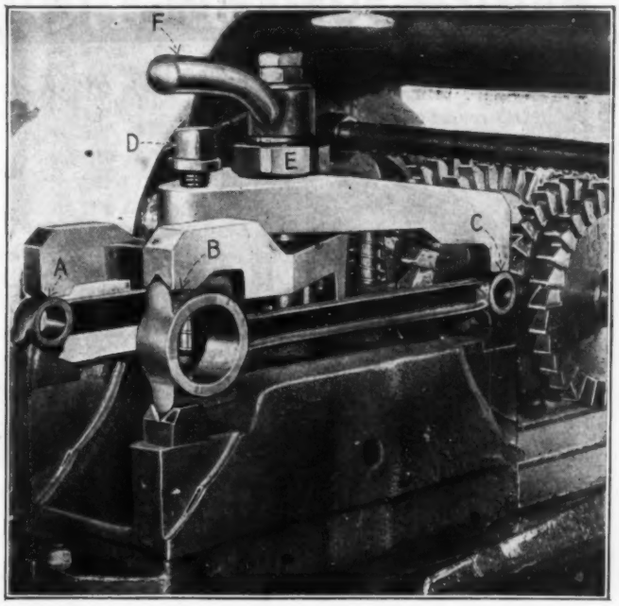


FIG. 1. SPECIAL DOUBLE-ENDED FIXTURE FOR MILLING CONNECTING-RODS

fixture. The springs shown release the clamp from the work, while the substantial setscrew *D*, which is threaded in the upper clamp and bears against the lower one, forces all four clamping points into contact with the work, and makes a fixture that can be easily loaded and unloaded. The fixture is reversible, a suitable index being provided, and the handle *F* clamps it firmly in either position.

MILLING FIXTURE FOR HOLDING ALUMINUM CRANK CASE

Another interesting operation from the Winton shop is shown in Fig. 2, where the aluminum crank case of the Winton six-cylinder motor is being milled on three sides in a special double-headed Lucas horizontal boring machine with a vertical milling attachment. The casting is mounted on trunnions and is held at various points, the special clamping vise at *A* showing one method of not only clamping the piece but of preventing vibration.

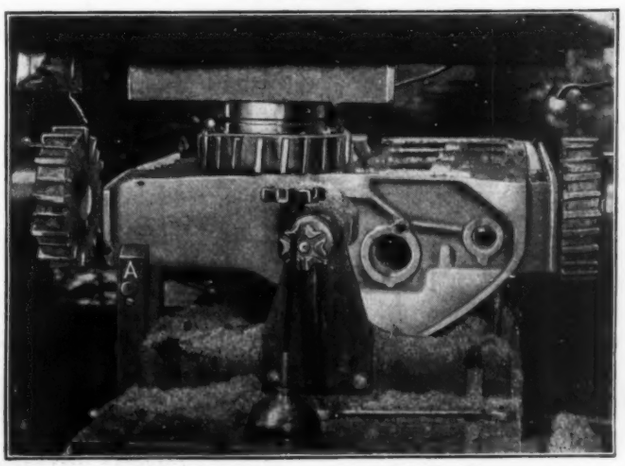
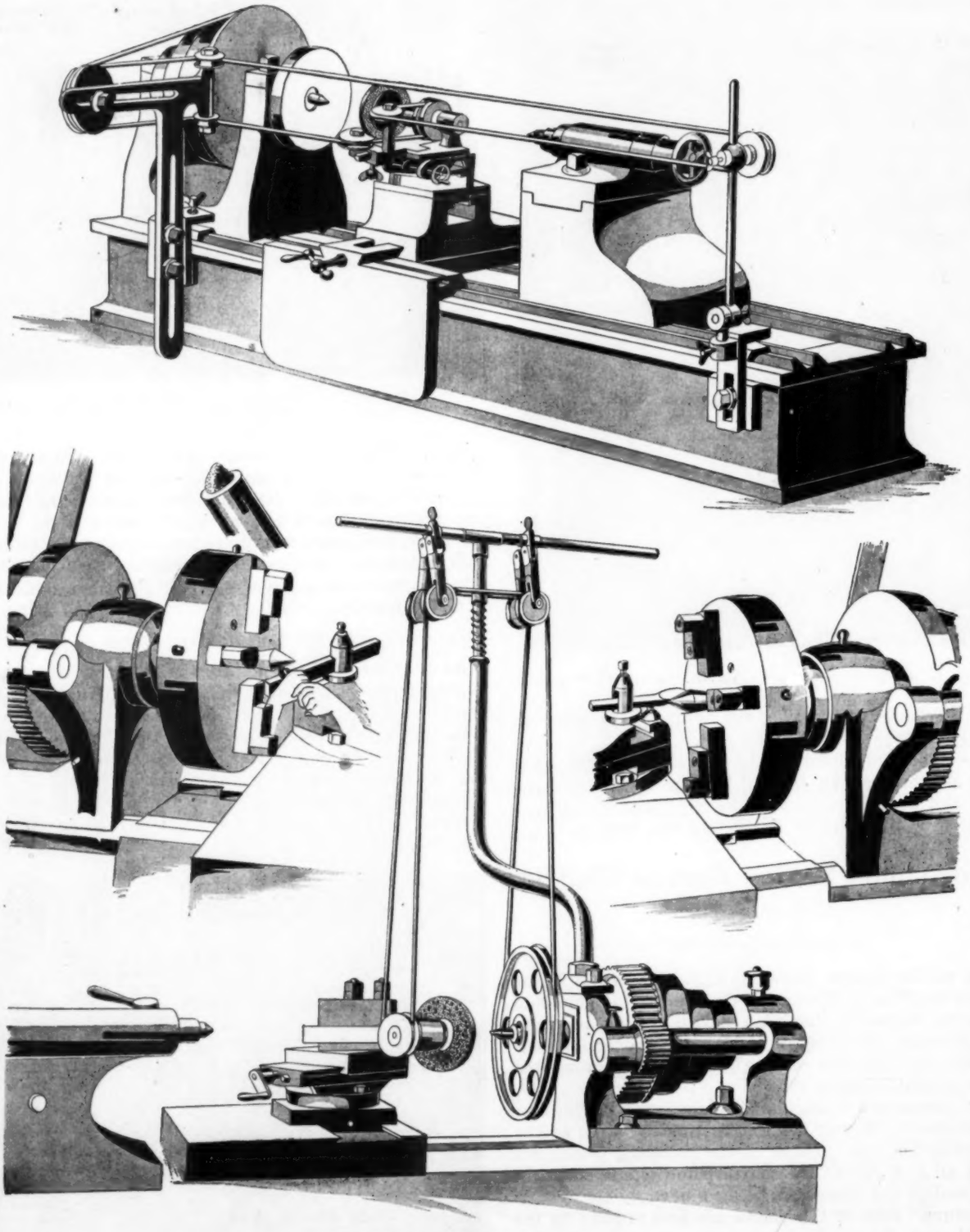


FIG. 2. MILLING THREE SIDES OF A CRANK CASE

FOR SMALL SHOPS *and* ALL SHOPS

By J. A. Lucas



CENTER SHARPENING METHODS

Strength of Gear Teeth

By S. J. BERARD
Instructor in Machine Design, Sheffield Scientific School, Yale University

Some short-cuts in the design of gears are here presented. With the aid of the tables and diagrams given, the problems of determining the force which a given pair of gears will transmit and the pitch necessary to transmit a given force when the speed is known, are much simplified.

THE load transmitted by the teeth of a gear and pinion depends on the weakest tooth; and when both are of the same material the pinion is the determining factor. This is due to the necessary undercutting at the base of the tooth in the pinion to give clearance for the teeth of mating gear, as shown at *AB* in Fig. 1.

When different materials are used, as for instance, a cast-iron gear and a steel pinion, the weakest tooth may be (and usually is) in the gear; or it may be in the pinion even though the latter is the tougher material. Hence it becomes necessary to investigate a given case with some care. The purpose of this article is to suggest some simple methods for determining the force a pair of gears will transmit, and for finding the pitch of gear teeth required to transmit a given force when the velocity of the teeth at the pitch point is known.

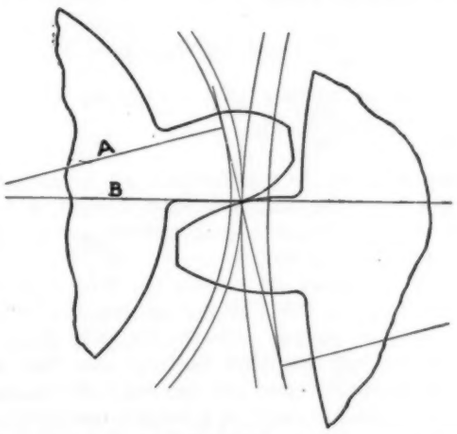


FIG. 1. GEAR AND PINION TOOTH OUTLINES

In applying the well-known Lewis formula, the selection of the tooth factor y is governed by the number of teeth in the pinion if both are of the same material. But when the materials differ, the formula should be tried out for both gear and pinion. Gears are made of cast iron, cast steel, semi-steel, steel and bronze. Pinions are made of cast iron, steel, bronze, rawhide, paper, fiber, cloth, etc., with varying degrees of strength.

The Lewis formula is

$$F = SPby \qquad (1)$$

where F = force acting at pitch point in lb.;
S = working stress in pounds per square inch at base of tooth;
P = circular pitch in inches;
b = width of face in inches;
y = tooth factor.

Values of y for different numbers of teeth and for different systems may be obtained from the diagram, Fig. 2, by dropping from the given number of teeth in the top line to the proper curve and reading the result at the left. Complete tables are given in most of the engineer's handbooks. The value of S depends upon the material and the velocity of the tooth in feet per minute at the pitch point. It decreases as the velocity increases due to the increasing rapidity of the tooth impact. If we assume a gear and pinion at rest, the velocity is zero; the allowable stress becomes a maximum and equals the static stress S_s. If we multiply S_s by $\frac{600}{600 + V}$, a "strength factor" introduced by C. G. Barth, the results practically agree with those given by Mr. Lewis in a table of working stresses for different velocities V. The width of face is usually expressed in terms of the circular pitch as $b = kP$, in which k, the "face factor," varies from 2 to 5, 3 or 3½ being a common assumption.

Substituting for S and b their equivalents as above, the Lewis formula (1), becomes

$$F = S_s \frac{600}{600 + V} kP^2y \qquad (2)$$

Table I gives values of S_s for various materials.

TABLE I. VALUES OF S_s FOR VARIOUS MATERIALS *

Material	S_s
Steel:	
Chrome nickel, hardened	100,000
Chrome vanadium, hardened	100,000
Alloy, casehardened	50,000
Machinery	25,000
Cast	20,000
Bronze:	
Special high-grade	16,000
Ordinary	12,000
Cast Iron:	
High-grade (semi-steel)	15,000
Good	10,000
Ordinary	8,000
Rawhide	8,000
Fabroil	8,000
Bakelite	8,000
Cloth	8,000

* From Leutwiler's Machine Design.

Values of the "strength factor" for velocities up to 3200 ft. per min. may be taken from the diagram, Fig. 3. Using this factor directly in the formula simplifies the calculation.

A few examples will serve to show the method of choosing the proper tooth factor y to use in cases where materials differ.

Example 1. A 30-in. cast-iron gear, 3¼-in. face, 3 pitch, 15 deg. involute teeth, meshes with a 6-in. steel pinion. What force can be transmitted when the pinion makes 200 r.p.m.?

Assume S_s = 8000 for gear, 20,000 for pinion.
Number of teeth in the gear, $3 \times 30 = 90$.
Number of teeth in the pinion, $3 \times 6 = 18$.

$$\text{Velocity } V = \pi \times \frac{6}{12} \times 200 = 314 \text{ ft. per min.}$$

$$P = \frac{\pi}{p} = \frac{\pi}{3}$$

From Fig. 2, $y_g = 0.117$ for the gear
and $y_p = 0.083$ for pinion.

Substituting in formula (2), we have

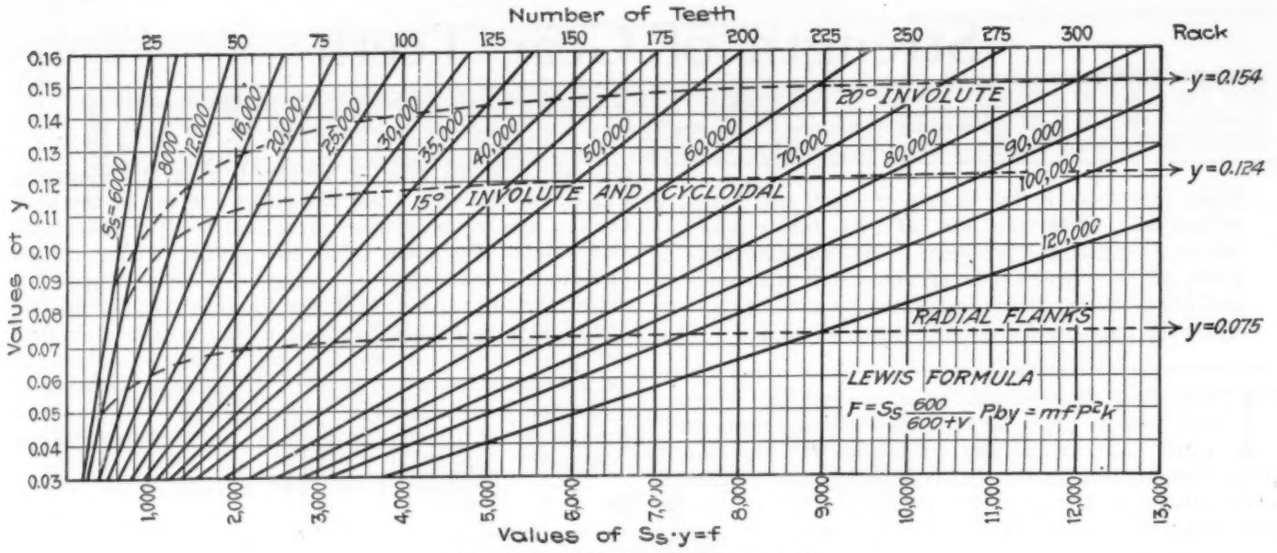


FIG. 2. TRIAL FACTOR DIAGRAM

(a) for the gear, $F_g = 8000 \times \frac{600}{600 + 314} \times \frac{\pi}{3} \times 3\frac{1}{4} \times 0.117 = 2100$

(b) for the pinion, $F_p = 20{,}000 \times \frac{600}{600 + 314} \times \frac{\pi}{3} \times 3\frac{1}{4} \times 0.083 = 3700$

Since F_g is less than F_p, it is quite obvious that the gear tooth is the weakest and it determines the maximum safe load that can be transmitted at the given speed.

It will be noticed that the portion $(\frac{600}{600 + V} \times P \times b)$ of the general equation is common to both gear and pinion; hence it is only necessary to multiply the value of S_s for each material by the proper tooth factor y in order to determine which governs.

Thus, $S_s y$, *or* "trial factor" is,

(a) for the gear, $8000 \times 0.0117 = 936$,

(b) for the pinion, $20{,}000 \times 0.083 = 1660$,

Showing that for this particular case we must use $S_s = 8000$ and $y = 0.117$, based on the gear tooth.

By inspection the proper value of the trial factor is easily determined from the diagram, Fig. 2, as follows: From the given number of teeth on the top line, drop to the curve of the proper tooth system, then move horizontally to the static stress line and drop to the base where the value of $S_s y$ will be found.

Let the trial factor be

$$f = S_s y \text{ from Fig. 2} \quad (3)$$

and the strength factor be

$$m = \frac{600}{600 + V} \text{ from Fig. 3} \quad (4)$$

Substituting in formula (2), we obtain

$$F = mfP^2k \quad (5)$$

$$= mfPb \quad (5a)$$

This presents the Lewis formula in a very simple form to use with the accompanying diagrams, making it possible to investigate a gear problem very quickly with a minimum of error.

Example 2. Suppose we replace the 6-in. steel pinion in Example 1 by a 5-in. bronze pinion for which S_s is 12,000, and the number of teeth 15. Fig. 2 gives the trial factor as 900 for this pinion. As this is less than that previously found for the gear, the pinion has the weakest tooth, although of stronger material; and it

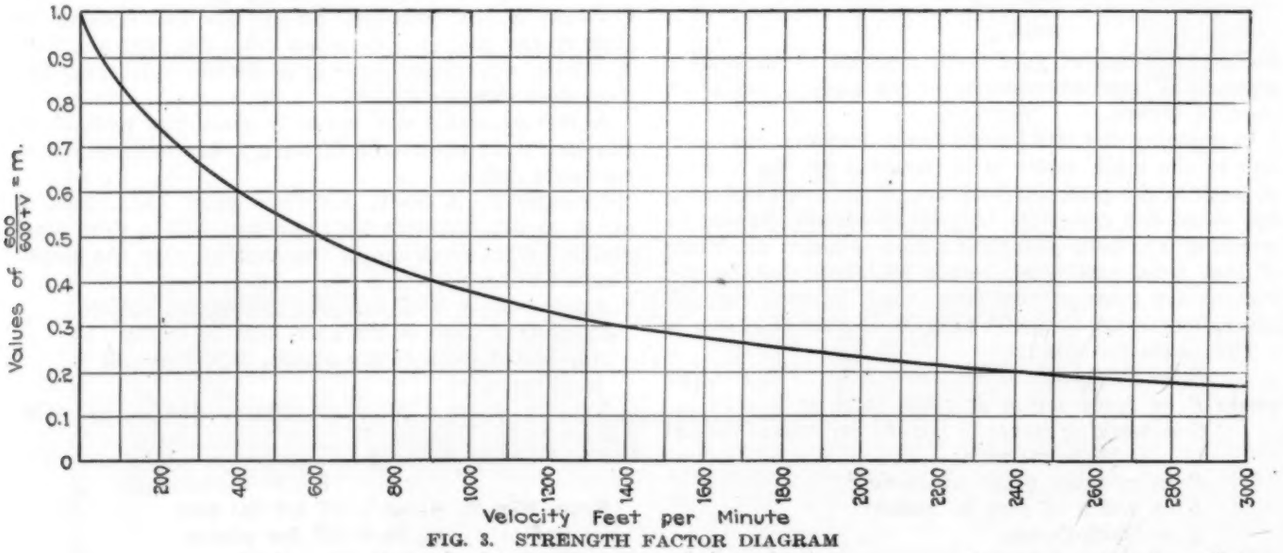


FIG. 3. STRENGTH FACTOR DIAGRAM

determines the maximum safe load the gears will transmit at the given speed. Calculate the force as before, based on the pinion.

TABLE II. DIAMETRAL AND CIRCULAR PITCHES

Diametral Pitch = p	Circular Pitch = P	p	P	p	P
1	3.141	5	0.628	20	0.157
1¼	2.513	6	0.524	22	0.143
1½	2.094	7	0.449	24	0.131
1¾	1.795	8	0.393	26	0.121
2	1.571	9	0.349	28	0.112
2¼	1.396	10	0.314	30	0.105
2½	1.257	11	0.286	32	0.098
2¾	1.142	12	0.262	36	0.087
3	1.047	14	0.224	40	0.079
3½	0.898	16	0.196	48	0.065
4	0.785	18	0.175	60	0.052

The method may also be used in determining the proper pitch of a pair of gears to transmit a given force at a given speed. It is first necessary to assume a probable pitch as a basis. This is difficult to fix and only experience and good judgment will suggest a fair assumption. Accordingly, we assume some arbitrary value of the diametral pitch p, calculate the number of teeth, determine the trial factor f, and the strength factor m; assume k in the face factor, and, after solving for the circular pitch in

$$P = \sqrt{\frac{F}{mfk}} \qquad (6)$$

determine the corresponding value of the diametral pitch p, taking the nearest commercial size from Table II. This is checked with the assumed value by comparing the new number of teeth with the assumed. If too great a variation results another assumption is made.

It is important to note that the number representing the diametral pitch is a ratio, a pure number, and an inspection of Table II will show that the lower the number representing p, the greater the circular pitch P becomes. Hence it is very necessary to select the next lowest number for the commercial diametral pitch pitch after solving for the circular pitch P in formula (6).

Example 3. A 30-in. cast-iron gear meshing with a 6-in. steel pinion transmits 10 hp. at 200 r.p.m. of the pinion. Let the value of S_s be 8000 and 20,000 for the gear and pinion respectively; $b = 3P$. Suppose we assume $p = 3$, making 90 teeth in the gear and 18 in. in the pinion. From Fig. 2 we find the trial factors to be 950 for the gear and 1850 for the pinion; and the strength factor from Fig. 3 is $m = 0.650$. The gear has the weaker tooth. From the given data

$$F = \frac{33000 \times hp.}{V}$$

$$= \frac{33000 \times 10}{\pi \times 200 \times \frac{6}{12}} = 1050 \text{ lbs.}$$

From formula (6) $P = \sqrt{\dfrac{1050}{0.650 \times 950 \times 3}} = 0.754.$

From Table II we find that the next larger circular pitch is 0.785 with a corresponding diametral pitch of 4. This does not check favorably with our assumed number as it would give 120 teeth against 90. However, recalculation on the basis of 4 pitch does not alter the result appreciably; accordingly, we would use the 4 pitch. These methods are useful in checking up gears under varying conditions of loading and speed. It is often desirable to ascertain quickly whether a particular gear can be used under certain conditions where its previous record is not known. Given the load and knowing the speed, pitch, face and number of teeth, it is only necessary to determine the available load from formula (5a) and compare with the given or required load.

Women as Electric Welders

By D. C. Cook

The various occupations in which women were employed during the war are well known. In many industries they took over the work of men in a commendable manner and at present they are surrendering these positions to the returning soldiers as cheerfully as they accepted them.

The welding field claimed many and in this work women were especially efficient on bench work or on parts that did not require much strength. The keynote of their success is found in the intensive training which they were given before they were allowed to take part in actual production. This training was extremely important, especially in the case of welding, as anyone knows who has tried to fill a hole or weld two pieces, since he is more apt to enlarge the hole or the joint than to do otherwise.

GIRL STUDENT ON ELECTRIC WELDING

The illustration shows a girl student in the training school at one of the big ship yards. Here the students

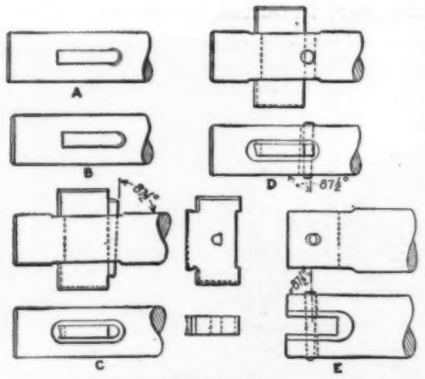
were placed under the instruction of experts from the Reid-Avery Co., Philadelphia, Penn., and after completing the course ably did their bit toward winning the war. It is to be also noted that every means is provided for the protection and comfort of the operator.

Taper-Pin Wedges for Boring Bars

BY J. PEARMAN
Brighton, England

On page 1195, Vol. 50, of *American Machinist*, S. B. Royal describes what he calls "the simplest method of securing tools in a boring bar." I do not consider that this method as described is the simplest method, and from the point of view of efficiency I consider it impractical.

In the first place, if the hole is reamed with a taper-pin reamer, and a pin fitted, this pin can only fit when in one position; that is, when driven home. If the pin be made to wedge the cutter before reaching this position, it can only bear along a line represented by the edge of the cone when a section is taken along the axis of the bar. When the pin is driven home and is bearing all around the semicircle, it is locked and no further adjustment can be made.



METHODS OF KEYING CUTTERS IN BORING BARS

Secondly, if the small end of taper hole is made the same diameter as the width of cutter, it will look as at *A* in the sketch. This would weaken the bar too much and would not look like a mechanical job. On the other hand, if the diameter of the large end of the taper hole is made the same as the width of the cutter, the slot will look as at *B*. The wedge shown in the cut accompanying the article on page 1195 shows half of a taper pin with a thickness equal to about 1½ diameters of the pin hole which is absurd.

I have always found it to be good practice to make emergency bars as at *C*, where a parallel hole is drilled at an angle of 87½ deg. to the axis of the bar, and, after the slot is cut and the cutter fitted, a parallel pin with a taper flat is made to slide freely in the slot. This pin has a bearing practically all around its semi-circumference and readily lends itself to adjustment.

A better method which is standard practice in the best shops in this country is shown at *D*. In this case, the pin is put through at right angles to the cutter and is drilled in the same manner; that is, 87½ deg. to the axis of the bar. The reason for the angular position of the hole is that if the hole was drilled square with the bar the edge of the cutter would act as a shearing tool on the flat surface of the pin, and, consequently, the pin would bear only on one edge of the cutter, instead of taking a bearing right across the face which is the only way to insure that the cutter will not work loose. At *E* is shown what I consider the best method for securing a cutter in a bar for boring a blind hole.

Cost of Making Offset Centers

BY HARRY SENIOR

On page 605 of *American Machinist*, Wesley McArdell takes W. D. Forbes to task for using too many machines on the job of making a pair of offset centers upon which to turn the crankshaft of a small engine.

I would not venture to criticize the time on Mr. Forbes' job for I might not be able to beat it; nor would I seriously criticize his methods, for they were doubtless planned in view of shop conditions and machines available. My criticism is directed rather against the critic, Mr. McArdell, because of the substitutes proposed.

Mr. Forbes first drilled the tap holes in the ends of his pieces, not because he could not think of anything else to do at the time, but because he wanted to use them for the purpose of holding the work on the planing-machine table by means of finger straps; a most commendable method. He did not expect a No. 40 drill hole to pilot a 2-in. drill past the interfering tap holes; I do not believe he ran that No. 40 drill down more than ½ in., for by the time the 2-in. drill had reached the interference it would have a 2-in. pilot hole to guide it. I should criticize only the use of so large a drill. Make it 1⅞ in. and give the boring bar something to do. A smooth, true hole was necessary here, and this meant two boring cuts anyway; $\frac{1}{32}$ in. is not enough to divide up between them.

After this hole is bored to size on the boring mill, what is simpler than moving over the table 2½ in. without disturbing the set-up, measuring by the micrometer dial on the crossfeed screw, and boring out the 1-in. hole, already drilled to $\frac{15}{16}$ in., before coming to the mill? What advantage has a milling machine over a horizontal boring mill on such a job?

As a substitute for the milling machine which Mr. McArdell proposes for the purpose of boring these holes, he suggests a four-jawed chuck in a lathe. Does Mr. McArdell seriously wish us to believe that he would undertake to bore two holes absolutely parallel in a bar held by this means? A faceplate, yes; but a chuck, never. It "couldn't be did." Again, assuming a faceplate instead of a chuck, it would take much longer to button and swing up one piece in this way than to locate and bore both pieces in Mr. Forbes' way.

Slotting for the soft-metal shoes under the setscrews; I will not venture to criticize either way; it's all a matter of taste, as the Hibernian gentleman said of the olives.

In the matter of gripping in a lathe chuck a piece of tool steel long enough to make the two centers and then parting the unsupported piece twice, I would rather be excused. I might be prevailed upon to make the two pieces upon opposite ends of the bar and part it with a power hacksaw, but this is exactly what Mr. Forbes did; only he made the bar short enough to need but one parting, held it on centers, and left the outside ends in the middle to be finished later. Instead of being unique I think this is exactly the method that would be followed by nine out of ten mechanics, if a draw-in chuck were available.

I agree with Mr. McArdell's last paragraph: "If we are going to produce or teach, let us use only those machines really needed"; but let us not go out of our way, or adopt precarious methods for the sake of doing on one machine what can be done to better advantage on two—especially if the other machine is lying idle beside us. This is not a brief for Mr. Forbes. I never met him, and know him only through his contributions to the *American Machinist*.

Details of Shaving Dies

By FRANK A. STANLEY

The application of shaving dies means the running of the blanked work through a second operation where accuracy and smoothness of contour are essential in the parts. The shaving die makes it possible to attain the desired results with less attention to the quality of the blanking dies and correspondingly more latitude is permissible in the upkeep of the latter tools.

IT IS of importance to give a little consideration to the subject of allowances for shaving of blanks. For any given material, or grade of stock, the condition of the contour of the blank will vary with the thickness of the metal, and the amount left for shaving should likewise vary with a fair degree of uniformity for different thicknesses of material. Similarly, the allowance for any given thickness should vary for soft, half-hard, and hard material. In order to cover these allowances for steel blanks of the three grades noted, Table I has been developed and has been given thorough tests in connection with numerous shaving dies operating on different classes of work.

This table covers thicknesses of metal from $\frac{3}{64}$ in. to $\frac{1}{8}$ in. inclusive, and also includes allowances for German silver and brass. For the latte. two materials, it will be noted that the shaving allowances are double those for steel of the same thickness. Table II is arranged to give allowances where two shaving cuts are taken. From the quantities under the heading "Allowances for second shave," it will be seen that the amount left for the second shaving operation is one-half that for the first. Thus, in the case of a soft-steel blank $\frac{1}{16}$ in. thick requiring two shaving cuts, 0.030 in. would be allowed on a side for the first shaving die to remove and 0.0015 in. for the second shaving operation, or a total of 0.0045 in. on a side or 0.009 in. over all, the blanking dies being made 0.009 in. larger than the finished size of the piece.

FIG. 1. A PILLAR-TYPE SHAVING DIE

The illustrations which follow represent some of the points in the construction of a set of shaving dies for a toothed blank $\frac{9}{16}$ in. in diameter by 0.050 in. thick. The blank is made from half-hard steel and has 13 teeth 0.0887 in. deep. The amount left in blanking for finishing in the shaving dies is 0.003 in. on a side or a total allowance of 0.006 in. The dies are of the pillar type and are shown in Fig. 1, and all parts are seen in the group, Fig. 2. The die proper is 3 in. square by $\frac{15}{16}$ in. thick. The die opening is made straight for a depth of $\frac{1}{4}$ in., below which it is tapered out for clearance at an angle of 1 deg. on a side. The die can thus be ground down to a depth of $\frac{1}{4}$ in. before its size becomes affected by the clearance angle.

There are different ways of getting out the stock from a die opening such as is required here. After the hole is drilled at the center to remove as much material as later operations will justify, the area between the teeth may be drilled out by two or three different-sized drills to leave but a narrow wall between the drill holes and a close margin between the holes and the die contour. Or, if the die opening as roughed-out is sufficiently large in diameter, a slotting tool may be applied to the work with the die indexed in the dividing head of the milling machine and the rough form of the teeth outlined by the shape of the slotting cutter.

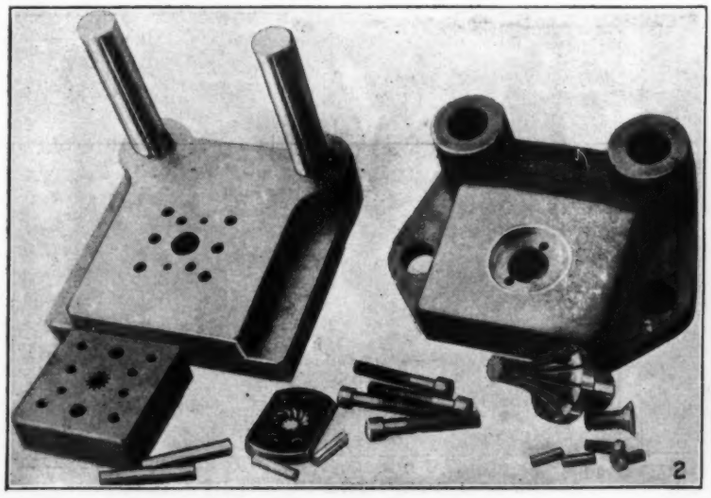


FIG. 2. DETAILS OF THE PUNCH AND DIE

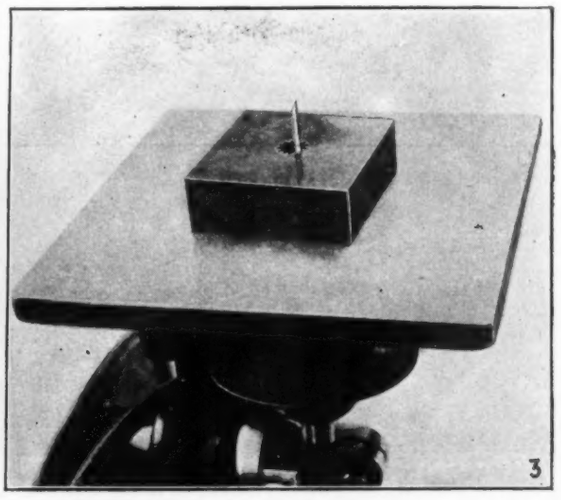
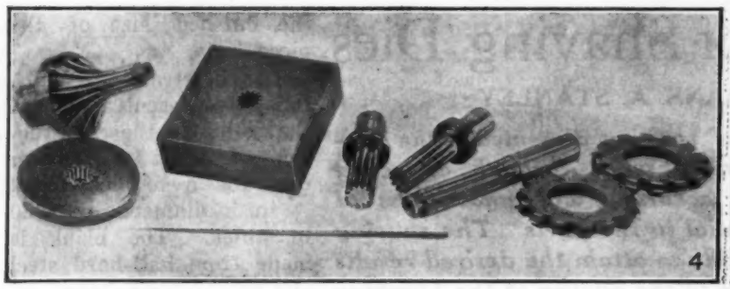
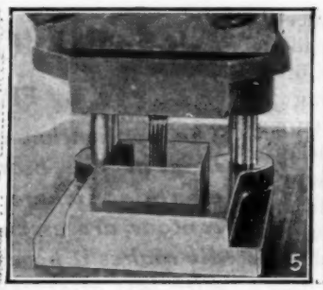


FIG. 3. DIE ON THE FILING MACHINE





FIGS. 4 TO 6. PRESS TOOLS AND SOME OF THE OPERATIONS IN PRODUCING THEM
Fig. 4—The punch, die, broaches and cutters. Fig. 5—Broaching the die. Fig. 6—Lapping the die.

In any event enough stock must be left to assure the toothed contour being finished to exact requirements. With a small toothed die like the one shown, the hand file and bench filing machine are relied upon to a large extent to assist in getting the tooth form roughed-down, and then with a combination of file and broach, the opening is finished.

The die is shown on the filing machine in Fig. 3. The halftone, Fig. 4 shows the broaches used in working the die to shape. There are two of these broaches, both shown to the right of the die. The punch, unfinished, is seen at the left-hand side with the roughed-out nesting plate in front. The formed milling cutters at the right are used for milling the broach teeth.

TABLE I. AMOUNT TO ALLOW ON A SIDE FOR SHAVING CONTOUR WHERE ONLY ONE SHAVE IS TAKEN

Thickness of Blank In.	Soft Steel In.	Half-hard Steel In.	Hard Steel In.	German Silver In.	Brass In.
3/64 (0.0468)	0.0025	0.003	0.004	0.005	0.005
1/16 (0.0625)	0.0035	0.004	0.005	0.006	0.006
5/64 (0.078)	0.0035	0.005	0.006–0.007	0.007	0.007
3/32 (0.0938)	0.004	0.006	0.007–0.008	0.008	0.008
7/64 (0.1094)	0.005	0.007	0.009–0.011	0.010	0.010
1/8 (0.125)	0.007	0.009	0.012–0.014	0.014	0.014

The sizes of the broaches differ but a few thousandths, as only a slight amount of stock is removed by each broach. Even this is taken out piecemeal; that is, the broach is forced into the die opening about $\frac{1}{64}$ in. deep, then removed and the filing machine used to work out the depth of the die toward the minute shoulder left by the cutting end of the broach. The broach is then forced in again, this time another sixty-fourth and the filing process repeated. After the first broach has been passed through the die by repeated stages, supplemented by working out the superfluous metal by the filing machine, the second broach, a couple of thousandths larger, is put through in similar fashion. The operation of forcing the broach into the die under a hand-screw press is represented by Fig. 5. For this purpose, the broach and the die are mounted in a pillar set. The tools are thus properly aligned, and the passing through of the broach is merely a case of alternating between the operations of forcing the broach in the slight distance referred to at each step and filing out to correspond to the advance of the broaching process.

The straight-shank tool at the side of the broaches in Fig. 4 is a lap which is used at a later stage in the finishing of the die. After the die has been sized by means of the broaches and filed for the slight clearance below the straight portion, it is drilled and tapped for the screws for holding it to the die base and also drilled for two $\frac{5}{16}$-in. dowels; it is further drilled for the screws and dowels for holding the nesting plate, and it is then hardened and is ready for lapping as shown in Fig. 6.

TABLE II. AMOUNT TO ALLOW ON A SIDE FOR SHAVING CONTOUR WHERE A SECOND SHAVING OPERATION IS USED

	Allowance for First Shave			Allowance for Second Shave		
Thickness of Blank In.	Soft Steel In.	Half-hard Steel In.	Hard Steel In	Soft Steel In.	Half-hard Steel In.	Hard Steel In.
3/64 (0.0468)	0.0025	0.003	0.004	0.00125	0.0015	0.002
1/16 (0.0625)	0.003	0.004	0.005	0.0015	0.002	0.0025
5/64 (0.078)	0.0035	0.005	0.006–0.007	0.00175	0.0025	0.003 –0.0035
3/32 (0.0938)	0.004	0.006	0.007–0.008	0.002	0.003	0.0035–0.004
7/64 (0.1094)	0.005	0.007	0.009–0.011	0.0025	0.0035	0.0045–0.0055
1/8 (0.125)	0.007	0.009	0.012–0.014	0.0035	0.0045	0.006 –0.007

The lapping is done under a sensitive drill spindle, with the lap held in the drill chuck as illustrated. Fine

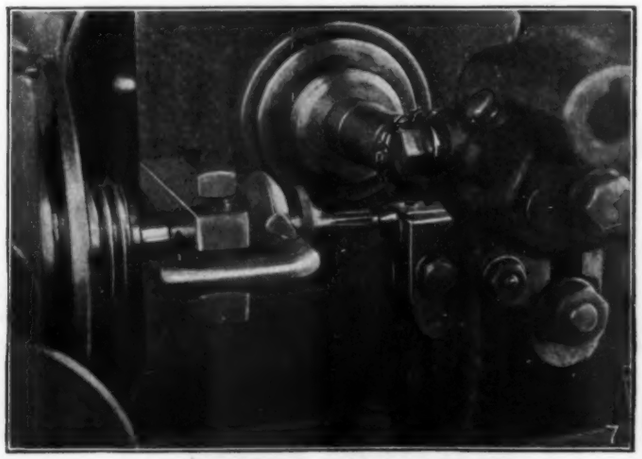


FIG. 7. MILLING TEETH IN THE PUNCH

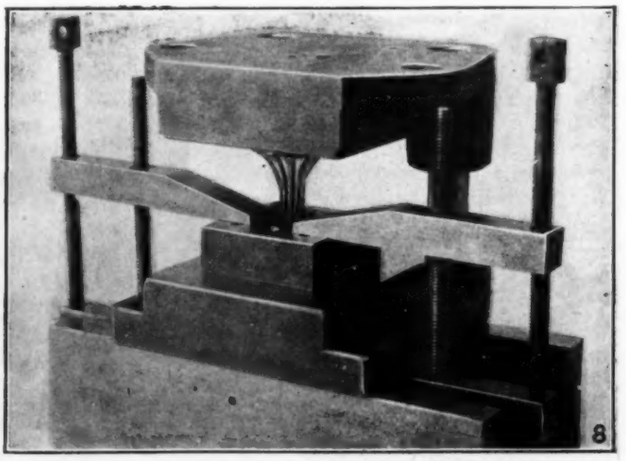


FIG. 8. FITTING THE PUNCH BY SHEARING

abrasive and oil being applied to the teeth milled along the lap surface, the spindle, without rotation, is moved up and down by the operating lever to lap out the entire toothed opening in the die and bring it to size with all points in the opening smooth and the working depth straight.

In turning the punch it is left with a large body that is swept out in a liberal curve and left straight for a length of 1 in. The diameter of the body is about 1¼ in. and back of the enlarged portion is a hub or extension which is ¾ in. in diameter. This hub and the enlarged shoulder are left a little over size but are afterward finished to fit closely in recessed seats bored out in the face of the punch holder as shown in Fig. 2. The working end of the punch is left ¼ in. long, Fig 4, and is turned down to a size equal to the diameter of the roots of the teeth so that it may serve as a pilot in a later operation.

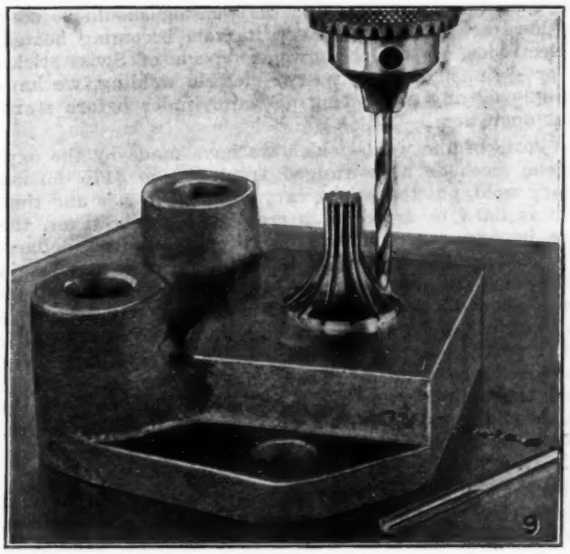


FIG. 9. DRILLING HOLES FOR THE SCREWS AND DOWEL PINS

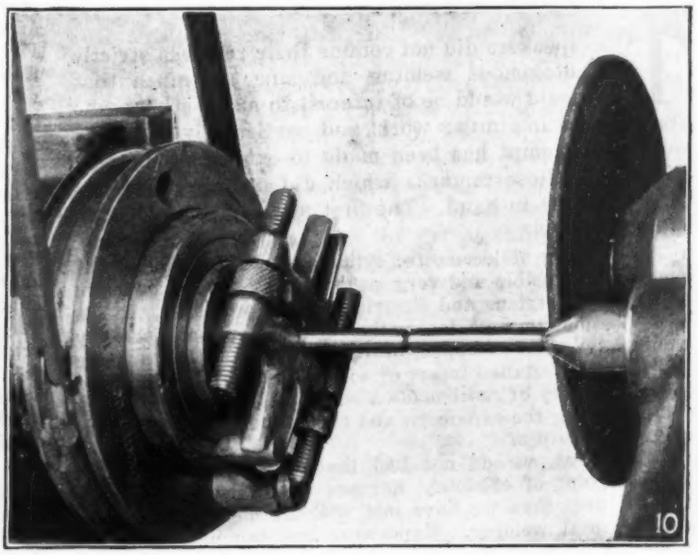


FIG. 10. GRINDING THE DOWEL PINS ON DEAD CENTERS

The punch teeth are then milled as in Fig. 7, with the work held on the dividing-head centers of the milling machine. The teeth are cut with great care to produce smooth results, accuracy of size and shape. The punch is secured in a holder and sheared into the die with the projecting pilot acting as a guide. The tools are set up for this operation as in Fig. 8 which illustrates the method of clamping the die on its base after the punch head has been slid down to enter the punch pilot into the die opening. With the tools thus arranged, they are transferred to the hand-screw press and the punch sheared in as explained.

The pilot of the punch is now cut off and the holes are drilled in its flange or shoulder for the screws and dowels. The screw holes are tapped and the punch is then hardened. After this the shoulder and shank are ground. The punch can now be seated in its holder as in Fig. 9 and used as a jig for drilling the holder for the screw holes and the holes for the dowels.

Up to this point, the die has not been secured to its base or shoe. The operation of locating it in line with the punch for drilling the screw and dowel holes in the base is accomplished as shown in Fig. 8. The punchholder is placed over the pillars in the die base and the punch entered into the loose die to align it properly with the punch. The clamps are applied as shown to hold the die temporarily for the drilling operation and the punch and holder removed. This leaves the die clear for drilling the screw and dowel-pin holes in the base.

The nesting plate is originally a disk of steel faced down to ¼ in. thick. It is drilled through the center to a size suitable for filing and broaching out to the shape and dimensions of the toothed blank which it will be required to hold on the die when in service. A hand broach is used in conjunction with the filing process and with the blanking punch which is made use of for sizing the nesting-plate opening. The nesting plate is in fact set up in the regular blanking dies, and the blanking punch is applied as a broach to assist in the working of the opening to desired size and form. With the punch entered slightly, to about $\frac{1}{64}$ in. depth. a guide mark is formed in the nest for enabling the opening to be worked out by means of the file and by the hand broach. After the opening is sized properly, the bottom is recessed and the top is countersunk or chamfered to leave a beveled surface for easy placing of the work in the nest. The clearance underside is cut in sufficiently to leave an actual full-size nesting opening about two-thirds as deep as the thickness of the stock. The recessed portion at the bottom forms a clearance space for chips. When the opening has been completed, the sides of the disk are milled away to leave a form similar to that shown in Fig. 3 and the holes are drilled for the screws and the dowel pins. This is done in alignment with the die holes by using the die as a jig.

A word may be added here in regard to the finishing of the various dowel pins used in these tools. The practice in the shop making these dies is to take a piece of steel long enough for two pins to be made from one piece. The stock is turned to about 0.008 in. above size and then nicked in the middle to a depth of $\frac{1}{16}$ in., after which it is hardened. It is now placed on dead centers in the grinding machine as shown by Fig. 10, and the diameter ground to size. The work is ground from one end to the clearance cut at the middle and then reversed on centers and ground from the other end. Following the grinding, the pins are separated by breaking them apart at the nicked dividing line.

Welding Locomotive Cylinders

At the annual convention of the International Railway General Foremen's Association, held in Chicago, Sept. 2 to 5, 1919, inclusive, a number of topics had been assigned for discussion, and upon these a symposium of papers were prepared by different writers describing their experiences in connection with the subjects assigned. One of the most interesting subjects under discussion was that in connection with the autogenous welding of locomotive cylinders, which follows in this article.

THE speakers did not confine their remarks strictly to autogenous welding and since so much that they said would be of interest to many others who are engaged in similar work, and particularly in repair work, no attempt has been made to extract from their statements those remarks which did not apply strictly to the subject in hand. The first speaker, L. A. North, said in part:

The welding of locomotive cylinders and other parts has been made possible and very successful by the introduction of the oxy-acetylene and electric welding processes. It has been possible to weld locomotive cylinders which formerly would have been scrapped, or repaired with either a brass patch or a dovetailed insert of some other metal. The weld in the majority of cases made a substantial and satisfactory job, providing the expansion and contraction had been properly taken care of.

At present, we do not feel that we have reached the highest point of efficiency, nor are we discouraged by the few failures that we have met with in the course of our experimental welding. Experience has taught us that in order to properly weld a locomotive cylinder, or casting, of any make or design by the oxy-acetylene method, it is necessary to thoroughly preheat to insure a uniform temperature in order to take care of the contraction and expansion, and to avoid cracking after the weld has been made.

The success of any weld depends largely on the care used in preheating and on the judgment of the operator making the weld. We cannot be too particular in this class of work to secure a high-grade mechanic so as to avoid a failure and cause the scrapping of a valuable piece of material.

One of the difficult welds, which we have made, was on a cylinder where the entire upper portion of the port area had been totally destroyed. This was repaired by casting in the foundry a gray-iron patch which was fastened to the cylinder by means of clamps, and after the cylinder was preheated to a uniform temperature, welding it in place. After finishing the weld, when the cylinder had cooled, a reinforcement was added by drilling through between the stud bolts and securing additional support by tap bolts, which were screwed into the main barrel of the cylinder.

It has also recently been possible to weld broken bridges in slide-valve cylinders, and this has been done successfully, effecting a saving of two cylinders, since, if it had been necessary to scrap the damaged cylinders, which were of an obsolete pattern, we would have to put a new pair on the engine.

J. T. Leach also dealt with electric and oxy-acetylene welding of locomotive cylinders. He said in part:

Some time ago, in repairing locomotive cylinders, we found it necessary to thoroughly inspect all cylinders before taking the locomotive into the shop for classified repairs, in order to assure ourselves that no new cylinders were required which might not be in stock, and which would then require the holding of the locomotive in the shop for a lengthy period until these could be cast and supplied by the foundry. However, now by the different methods of welding cast iron, a cylinder can be cracked or broken badly, and yet can be repaired successfully. The only question in this connection arising is as to the cost compared with the new cylinder.

In making electric welds on cylinders which are only cracked, we first pull the cylinder back into place as nearly as possible, by the use of a rod and clamp. Then the entire surface along the crack is cut out V-shaped at an angle of from 45 to 55 deg., and we drill and tap both sides of the crack for ⅝ in. or ¾ in. studs. These studs should be staggered; that is, one row is drilled down on the bend and the other staggered to the flat portion of the cylinder. The studs should be screwed in the cylinder ⅝ in. or ¾ in., and then cut off about ¼ in. from the casting. All dirt should be cleaned from the portion of the cylinder before starting on this operation, and the welding should be done at a slow rate in order to keep it from becoming heated. For electrodes, we use the ordinary grade of Swiss sticks, ⅜ in. or 7/16 in. in diameter. For electric welding, we have not employed any preheating of the cylinder before starting the operation.

The costs of the welds which we have made by the oxy-acetylene methods have ranged from $50 to $175 for an ordinary weld, but these jobs vary so much in size and time that it is hard to arrive at a true average; however, the saving in any case amounts to several hundred dollars. The procedure followed with the oxy-acetylene process is as follows: Cut out the cracked portion V-shaped at an angle of about 60 deg., and if the broken outside portion is bulged out, use a rod and clamp and pull up as nearly to the original position as is possible. Clean all the dirt from the areas to be welded. Then build a furnace of brick around the cylinder and by means of a charcoal fire, or torch, heat the cylinder to a cherry red. In some shops, an acetylene torch is used for preheating the cylinder, but that is an expensive method.

After the cylinder has been preheated to the required temperature, the operator begins to weld while the charcoal fire is maintained in the cylinder so that it will have a uniform heat. In welding, special silicon cast-iron sticks are used, and if these are not available, a good grade of air pump rings will answer. The welding on the cylinder should be continuous, and if the break is large, one operator should relieve the other, so they may work with the casting always at a uniform heat. If the casting is allowed to cool, the weld will crack. The charcoal, or torch, fire should be kept up for several hours after the weld has been completed, and then allowed to die out. This will insure a good weld. The oxy-acetylene welds I have witnessed cost considerable more than if the electric process had been used, but this was due in part to the lack of experience of the operator, and also to the methods followed.

William Gale spoke of the experience he had had with the welding of locomotive cylinders in the shops of the Chicago and Northwestern Railway Co. His experience in this line dated back to the first cylinder which was repaired in this manner in 1911, and this was successfully accomplished much to the gratification of the officials of the railway who had authorized the experiment. The welding methods which he described were much similar to those previously described, and consisted in preheating the cylinder to the proper temperature before applying the welding torch. Mr. Gale stated that from April, 1917, to May, 1919, there had been 27 cylinders successfully welded in the Chicago shops, and only one failure, this being due to the shell of the cylinder being too light to withstand the expansion caused by the preheating treatment. The cylinders welded had defects ranging from broken flanges on both sides to various sizes and kinds of cracks in the barrel. The oxy-acetylene torch was used for all the welding performed in these shops.

Another speaker, B. F. Harris, belongs to the older

school, and does not favor autogenous welding of locomotive cylinders if it is possible to avoid it. He prefers bands or shrink clamps rather than taking a chance of spoiling an expensive casting. When the case actually demands the use of welding, he follows the plan previously outlined, and says in addition that:

The fire should not be too strong at the beginning. Care should be taken to bring the heat up gradually to a red color, and after obtaining this result welding should begin, and under no circumstances should the fire be allowed to die while the weld is being made. Everything should be done to make conditions as comfortable as possible for the welder, and great care should be taken in selecting a mechanic for this work. A mechanic, to be a successful welder, should be a man of excellent judgment and be endowed with patience and aggressiveness, but not stubborn, and such a mechanic should make a successful welder; in the speaker's opinion, the successful weld depends as much or more on the mechanic than it does on the tools.

In making the weld, great care should be exercised to select the proper welding tip. Too small a tip results in cold shuts and slow work, while too large a tip will result in blowing the metal away, and because of the fact that we would have a high oxygen pressure, the work would be retarded, and it would have a tendency to burn out the carbon and silicon in the iron, causing it to become hard and brittle.

Some of the most successful work in the matter of welding was reported by J. H. Frizell, and his remarks were somewhat similar to those already noted, though interesting information may be obtained from some of the details which he mentioned Mr. Frizell stated:

The parts to be welded are cleaned thoroughly, then chipped out on a V at an agle of 45 deg. A furnace of loose firebrick is constructed around the cylinder, and if the cylinder is off the engine, a space of about 4 in. is left between the furnace wall and the cylinder all the way around, but if the cylinder is on the engine, the furnace wall is extended about 8 in. inside the frame, for simple cylinders; and, for compound cylinders, the furnace should extend to the center of the cylinder saddle. A piece of netting is placed in the cylinder, and also in the space between the furnace wall and cylinder, supported by an iron bar, ⅜ in. x 1½ in., thus forming a fire grate. About 3 in. of charcoal is placed on this grate, and also on the floor of the furnace, which should be about 6 in. below the bottom of the cylinder. The fire is started, and the cylinder heated to a brown color, or approximately 900 deg. F., at which time the welding is started, using a welder with an assistant to relieve him occasionally, and to attend the fire.

We have welded about 80 cylinders on our system in the past 15 or 16 months, 50 per cent. of these being welded in the Topeka shop, and of these latter, we have not lost a weld or had a single failure. We have had these cylinders break in other places, without any damage among the welds that have been made, one of these being on an engine which, after being in service for about two weeks, got a shot of water in the cylinder, shearing the crosshead key and knocking the front cylinder head out, and still the weld held. These cylinders are welded at a cost of from $175 to $300, which makes a good saving.

What Is a High-Grade Machine?

By George T. Trundle Jr.
Consulting Engineer, Cleveland, Ohio

The editorial headed "What Is a High-Grade Machine?" has put a question to the manufacturers and engineers that requires some very deep thought. It ends up with another question regarding the four factors: designing, material, accuracy of parts and assembling. Which plays a greater part in making a high-grade product?

The highest-priced automobile on the market today requires the same vital mechanism as the lowest-priced car. If we were talking of men we could perhaps draw a greater distinction. Even then, we would, most likely, encounter difficulties. Briefly, let us compare two men with equal heredity and environment, of the same age, and residing in the same town. One becomes the president of a large industrial institution, the other becomes a common laborer. They require the same amount of food, but still one has risen to a high position, the other has not. The successful man wears clothes that are expensive, the other wears a cheap suit. Nevertheless, we can not say that each is not successful in his own line.

The High- and Low-Priced Automobile

The high-priced automobile is dressed up in the expensive suit, the cheap car in the cheap suit. If, however, we are to compare achievements and cost of operating, probably the cheap car would outclass the higher-priced car. It will climb any hill the other car can and some the other can not. It may be slower but it will get there. The fuel and oil consumption, as well as the general upkeep, will be much less on the cheaper car, but still we all crave what we term the high-grade machine, the same as the laborer craves for the position of his more fortunate brother.

The successful man has the art of thinking, making decisions and doing big things and will gradually grow greater, while both the high- and low-priced automobile will gradually decrease in value. Something unusual must happen to make them increase. To produce these cars regardless of the price, it requires both of these men and a crew of other men to act as a connecting link between the two.

We now get to the four factors: designing may be perfect in every detail, but should the successful man, the manager of the company, fail to insist that the proper material be used, accuracy maintained and last but not least, the assembling be done with the greatest care, the whole scheme falls through.

The Importance of the Four Factors

That each of the four factors is important is very evident, whether you are building a cultivator or an airplane. Take the airplane first. The engine requires all four factors. We first have the designing which has been developed in stages—in the mind of the inventor, on the drawing board, in the machine shop where working models are built and assembled.

The design may be correct, the material of the best and the parts produced accurately. Suppose the assembling be done carelessly and the machine goes to the test field for the experimental flight. A bolt in the propeller blade having been tightened beyond its strength causes a fracture. A bearing was put together without oil. A shaft has been put in place without being thoroughly cleaned. A bolt or rivet has been left out of the rudder. The result of the test is a failure and perhaps a loss of life.

In assembling it is easier to detect mistakes in parts than in the process of manufacturing. This same thing applies to the manufacture of the cultivator. In my opinion, the order of importance of the four factors entering into a high-grade product are: designing, assembling, material and accuracy.

What makes a machine high grade? A machine is made to perform a given task. We can speak of a high-grade cultivator as we do of a high-grade airplane. The design on any device should necessarily be the best to perform the given task.

Assembling requires extreme care and supervision. A loose or fractured bolt, stripped threads, failure to

use cotter pins or lock washers where specified and to assemble bearings properly are just as detrimental to the cultivator as they are to the airplane.

Material should likewise be carefully selected with a proper factor of safety for each individual part. If the designer, after carefully considering the work a particular part should do, specifies either steel or bronze castings and the production department puts in cast iron, the machine may break this part the first day it is put to work, and the whole machine will be condemned. Therefore, the selection of material is important.

Accuracy should be maintained within a given tolerance controlled by gages to assure perfect functioning of each detail which goes to make up a complete machine.

Summing Up

In summing up, is it not true that the assembling is next in importance to the designing, even though we know that the material put into these parts is of vital importance?

Suppose I own an automobile and a cultivator and they should both stop functioning. What is the usual cause? Broken or worn-out parts resulting from inferior material being used. Lost or stripped bolts, or rivets becoming loose. Burned-out bearings can be caused by many things, such as failure to use the proper materials; insufficient care used in assembling; shafts out of line, or failure to provide sufficient means for oiling.

The highest step or highest degree in any series is the highest grade. It is the highest position or standing. To determine what a high-grade machine is, it is only necessary to classify the machines of a certain kind as to how they perform their intended functions.

A high-grade machine is one designed to perform some specified need in the best and most economical way. How can we produce such a machine so that it will function as designed, in the most efficient way, considering upkeep and operation? It must be well designed; extreme care must be used in assembling and the material must be carefully selected for each part, in order that it will perform its operation without breaking and undue wear. The accuracy in machining the parts must be in accordance with the operation of each individual part in its place in the assembled machine.

It is therefore my belief that the four factors pertaining to a high-grade machine are: designing, assembling, material and accuracy.

Apprentices Here and in Europe

By John Parker

Articles by E. J. S. Halvorsen (page 77) and Fred Price (page 654) are both timely and interesting, and we will find that in the near future we will need more men trained in shops than we will be prepared to supply.

This condition is due partly to indifference on the part of manufacturers having shops large enough to warrant a regular apprentice system and partly to antagonism by a class of people who want to reduce a boy's chances of learning a trade, so as to conserve their own high rate of wages regardless of the rights of others. This last excuse seems to me to be a very poor one and far fetched; according to my view, a young man who has served a regular apprenticeship will not wish to work for small wages and will not have to if he has been properly trained in the principles and practice of the trade he has learned; he should be in a position to boost the trade instead of harming it for others as these people imagine he will do.

The training of young men in the average trade school is not as complete as could be wished; one adverse condition is the lack of productive work, or work made on the same basis as would be required in a shop, namely: basis of cost in competition with other shops, so that when the completed tradesman leaves the school as a journeyman he can hold his own in any practical shop. Another condition apt to exist is that the instructors are likely to remain in a rut and not keep abreast of the times in their respective trades on account of there being no competitive inducement to work hard to produce on a business basis either for themselves or their pupils, which results in the graduates not being able to stand on their own feet, so to speak, when forced to earn a living at their trade.

In regard to the standard of apprenticeship of fifty years ago I would go Mr. Price one better and substitute the standard of 1919 as worked out by a large corporation in which shop mathematics, arithmetic and drawing are added to the shop practices of fifty years ago, rounding out to a great extent what the apprentice lacked in the old shops and which, if he ever got, was by mighty hard work of his own.

Two Months in the Machinist Apprentice Shops

In the machinist apprentice shops to which I refer, the boy is taken in hand for the first two months and taught to rough-turn shafts, etc.; then for three months work on finish turning; two weeks or more on rough-grinding machines; three months' time on grinding finished work; six months on inside turning and threading; three months on shaping and milling machines; twelve months tool, and general machine work; and the balance of the four years on work in shops all over the plant.

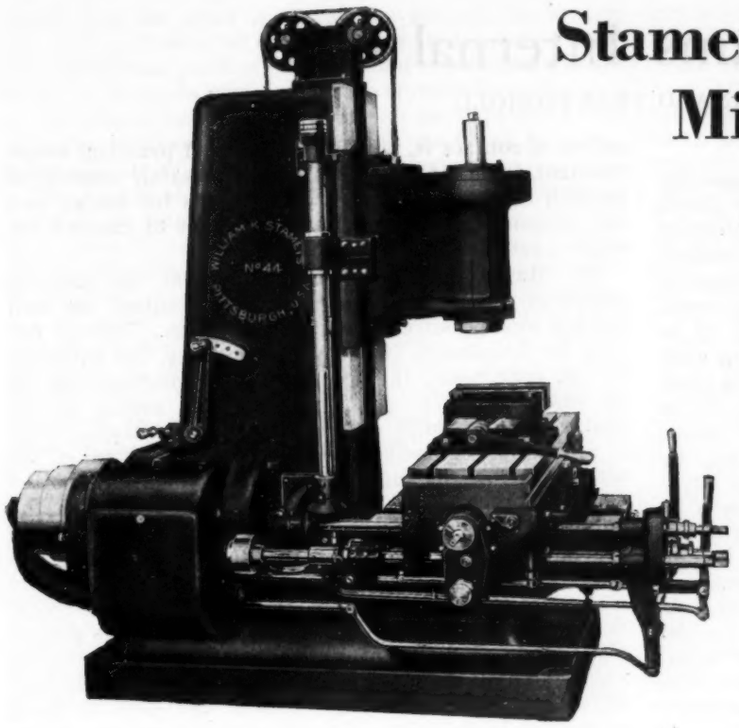
In the pattern-making apprentice shop, the boy is taught for the first two months to sandpaper and finish patterns; then for six months he is taught to turn up core prints and small plain patterns, after which he is given work in which are a few plain round cores and other work of like character until he commences to grasp the principle of thinking in space, which is the patternmaker's chief asset. After this, he is brought along by gradual stages until at the end of his four years he should step forth a completed journeyman capable of filling a tradesman's position in full.

While these young men are learning the trades, they are also accorded an hour's study each day in school in mathematics, arithmetic and mechanical drawing and they must have a certain percentage in both school and shop practice or they will not be allowed to complete the course and gain the one-hundred-dollar bonus and the diploma which is given for satisfactory completion of their four years' apprenticeship.

Young men trained in this way will be a credit to their trades and to the school and shop that graduates them. They will never be a menace to their fellow work men by working for smaller pay, as by virtue of their training and skill they should be able to command the highest rates paid anywhere.

In regard to the so-called superiority of the European mechanic, I will say that I have yet to see any of their young mechanics who could approach, in skill, speed and efficiency, the young American mechanic.

Stamets No. 44 Vertical Milling Machine



The heavy-duty vertical milling machines may be considered as being divided into two general types: one having a stationary head with an adjustable knee; the other having an adjustable head, and following to some extent the design of a slotting machine. The design shown herewith differs somewhat from both of these types of machines.

THIS machine has the distinction of a one-piece frame without an adjustable knee—a design recommended by the makers as particularly suitable for heavy cuts with fast speeds and equally well adapted for lighter classes of milling. The design is said to have many advantages over the knee-type machine, such as greater stability due to the elimination of the knee bearing and also as affording more convenience of operation. By this construction the table is permanently located 32 in. from the floor, the same height as a planing-machine platen, which is accepted as the most convenient height for the operator in handling castings, or other parts to be machined. The head bearing on the column is larger than the knee bearing on a machine of corresponding size while the weight of the head is much less. This weight is constant and can be accurately counterbalanced, relieving the bearing of overhang and uneven strain, a feature that may be quickly appreciated by reference to the illustration. This principle of design maintains alignment which is an important matter, particularly where fixtures for holding the work are used extensively.

A power quick return, operated at a speed of 11 ft. per minute, is provided for the vertical, horizontal and cross feeds, permitting rapid adjustment. This arrangement greatly increases the production of the machine by reducing the lost time between cuts and avoids the slow, tiresome process of shifting the parts by hand. The power quick return is entirely independent of the regular feeds and interference between the two is prevented by a simple interlocking device. Taper gibs are used for all slides throughout the machine and automatic trips are provided for the longitudinal cross and vertical feeds. These feeds are all reversible and driven through friction by spur gears direct from the back gear shaft. The drive from a three-step cone pulley furnishes 12 spindle speeds, nine of these through back gears and sliding gears. The latter are operated by the lever shown above the gear box on the machine. With this lever in neutral position, the horizontal lever at the back of the gear box can be moved to the right, engaging the jaw clutch on the drive shaft and giving three belt speeds suitable for small cutters. The two levers are interlocking, preventing any conflicting conditions of the gears. All gears for both drive and feeds are cut from high-carbon-steel forgings, or steel castings. An oil reservoir having a hinged cover furnishes ample lubrication to all bearings which are connected to the oil supply by means of brass tubes. These bearings are provided with wool felt oil retainers. Individual motor drive can be furnished when required. The machine is manufactured by Wm. K. Stamets, Pittsburgh, Penn.

Specifications of Stamets No. 44 Vertical Milling Machine

Distance, spindle to column, 15 in.; working surface of table, 14½ x 48 in.; total length of table, 56 in.; longitudinal feed, 44 in.; cross-feed, 16½ in.; vertical feed to head, 19 in.; maximum distance, spindle to table, 24 in.; minimum distance, spindle to table, 0 in.; minimum head bearing on columns, 19 x 25½ in.; adjustment of spindle sleeve, 6 in.; size of taper hole in spindle, No. 12 B. & S.; diameter of spindle at taper, 4 in.; number of spindle speeds, 12; range of spindle speeds, 12 to 200 r.p.m.; number of changes of feed, 12; range of feeds, ⅝ to 17 in.; diameters of cone pulleys, 12, 13¾ and 15½ in.; width of belt, 3½ in.; T. and L. pulleys on countershaft, 16 x 3¾ in.; speed of countershaft, 420 r.p.m.; power, quick adjustment of table, saddle or head, 11 ft. per minute; height of machine, 7 ft. 7 in.; length of table, 8 ft. 4 in.; distance front to rear, 8 ft. 6 in.; net weight, 7800 lb.

The Williams Internal Gear

By REGINALD TRAUTSCHOLD

Editor, *American Machinist:*

The comments upon my article, "The Williams Internal Gear," by L. D. Hayes, on page 527, are gladly received, for it enables me to clear up some ambiguity which may have arisen in the minds of other readers.

Mr. Hayes first raises the question of the manner of measuring the obliquity of the internal gear teeth. These teeth are of a form similar to the teeth of an involute rack; that is, the profiles of the teeth are plain flat surfaces inclined to the central plane of the tooth spaces at a definite angle. The profile planes of the teeth of an involute rack, if extended to infinity, would be tangent to a circle of zero diameter, or radius. By causing the rack to take the form of a segment of a circle, or a complete circle, as in the case of the Williams internal gear, without in any way modifying the profile of the teeth, the profiles of the respective teeth become tangent to a circle of measurable radius, the center of which is located at a finite distance from the teeth. As the teeth of the gear, the planes in which such profiles lie, are all tangent to the same circle, the center of the circle must be the same as the center of the gear; that is, the circle of profile plane tangency is concentric with the gear.

Any normal radial plane of the gear cutting the profile of a gear tooth on the pitch circle will measure the radius of such circle of profile tangency, for it is evident that the obliquity of the profile plane to the normal radial plane meeting on the pitch circle is definitely fixed. A second normal, radial gear plane passing through the center of the adjacent tooth space—that is, bisecting the tooth space—will be inclined to the first radial plane intersecting the tooth profile on the pitch circle at an angle subtended by one-half the tooth space and equal to one-quarter the pitch angle of the gear. The obliquity of the gear-tooth profile, which is constant, and equal to one-half the tooth-space angle, is measured from the plane bisecting the tooth-space angle, not the radial plane intersecting the tooth profile on the pitch circle. Since the obliquity of the profile plane, which governs the radius of the circle of profile plane tangency, is measured from the radial plane cutting the tooth profile on the pitch circle and not from the plane bisecting the tooth space, the measure of profile plane obliquity is the sum of the two angles, one-quarter the pitch angle of the gear plus one-half the tooth-space angle. The obliquity of the tooth profiles about the bisecting plane of the tooth space is the governing factor, not the obliquity of the profiles with the plane bisecting the tooth. The tooth spaces are similar for internal gears of different pitch or diameter, while the form of the gear teeth under such conditions will vary.

The limits of the usable section of the path of point of contact are set by the radii mentioned, for outside such limiting points the approach and recession of the generated pinion-tooth profiles are not normal to the path of point of contact, so that normal contact between meshing teeth could not occur outside of the usable section of the path of point of contact. If the usable section of the path of point of contact is considered as being the arc of a circle—as to all practical intent and purpose it is—this is obvious, for the normal from any point on the arc of a circle is a radiant to such arc. Actually, the curve of the path of point of contact for Williams internal gears is of the involute class, but the section of the path subtended between the limiting points of contact is, within the limits of practical measurement, the arc of a circle and may be safely considered as such in the development of formulas for design and for comparison with the paths of point of contact for other systems of gearing.

Mr. Hayes then raises the point that the limiting points of the usable path of point of contact are well beyond any possible action of the teeth. This is not true for frequently, if not quite generally, the obliquity of the gear teeth, their depth and proportions can be so selected that the full length, or very nearly, of the usable path of point of contact can be utilized. This is a question of design. In the involute system of internal gearing, the angle of approach is definitely limited to equality with the pressure angle, and, though the angle of recession is theoretically unlimited in such system, it is very definitely limited by practical considerations. The angle of recession is controlled by the addendum dimension of the mating pinion tooth, or the outer diameter of the pinion. This same dimension, outer diameter of pinion, controls the recession angle in the Williams system, but with this one decided difference. In the involute system, the path of point of contact is straight and inclined to the common plane of tangency at the instant axis, so that the outer diameter of the pinion intersects the path of point of contact relatively near the instant axis, while in the Williams system the path of point of contact curves toward the pinion and in so doing materially delays its intersection with the outer circle of the pinion. As the path of point of contact is likewise curved throughout the approach, the angles of approach and recession and their sum, the angle of contact, are all respectively much greater in the Williams system than in the involute.

The approach action of an internal-gear combination, proportioned according to the involute system and having a pressure angle equal to that at which the action commences in the Williams system, would not be the same in magnitude as in the Williams system—as stated by Mr. Hayes—but very much less. Due to the distinctive curvature of the path of point of contact in the Williams system, a tangent to the path at point of first contact would not pass through the instant axis, but through a point on the common axis considerably further removed from the center of the gear. Since the path of point of contact for any system of gearing must pass through the instant axis, such path, for involute gears with a pressure angle equal to that of Williams gears at instant of first contact, would intersect the inner diameter of the internal gear in quite close proximity to the instant axis, so that only a small portion of the limited approach section of the involute path of point of contact would actually be utilized.

The practical success of the involute system indicates beyond any question that a moderate, or even a relatively considerable obliquity in the direction of contact at the instant axis is not seriously detrimental to the efficient operation of gearing, but there is nevertheless a limit beyond which the obliquity cannot be carried without unduly decreasing the efficiency of transmission. A 20-deg. obliquity for the involute system is not considered a serious obstacle at the present time, but a 30-, 35-, or 40-deg. pressure angle would be certain to develop decided decreases in efficiency. Furthermore, despite the successful use of involute gears with a reasonable pressure angle, it must be con-

ceded that the chief merit of the epicycloidal system lies in the absence of any obliquity in transmission at the instant the point of tooth contact crosses the instant axis. It is at this instant that the transference of power is the most effective and the logical point at which the effective component of the force should be at its maximum; that is, normal to the common axis plane.

The reason that the mechanical efficiency of involute internal gearing is as high as it is, is due to the fact that power is transmitted between the gears throughout the arc of contact, so discounting to a certain extent loss in efficiency at any particular point. During approach, the obliquity in transference is at a minimum at the instant of first contact and increases as the contact advances, so that during recession it is less and less efficient than it is at the instant axis. The result is that wear is concentrated on the flanks of the internal gear teeth and as the gears wear the efficiency in transference grows less. In the epicycloidal system, with its 100-per cent. efficiency in power transmission at the instant axis, transference is less efficient at both commencement and ending of contact than in the involute system, while the concentration of wear occurs about the pitch lines of the teeth of both gear and pinion. Due to such concentration of wear, there is a tendency for epicycloidal gearing to increase somewhat in efficiency after a moderate use, or until the wear on the teeth about the pitch line becomes objectionable.

Transference of Power

The transference of power in the Williams system is not so effective at the instant axis as in the epicycloidal system, but it is quite as efficient, if not more so, at such point as in the involute system. During approach, the transference is not quite so effective as in the involute system, it is true, but during recession it is very much more so. Furthermore, such concentration of wear as does occur will take place on the flanks of the pinion teeth, destroying the contact during which the obliquity in transmission is at the maximum and so developing a tendency for the efficiency of the gearing to improve with age, not to decrease, as in the case of involute gearing. Quite aside from the superior operation and smoother running qualities of Williams internal gears, due to their longer arc of contact and the distinctive path of point of contact and the form of the teeth, their transference of power—the mechanical efficiency in transmission—is more effective than in gearing designed according to either the involute or epicycloidal system with teeth of similar proportions.

Mr. Hayes winds up his interesting comments with reference to the important commercial consideration of production costs, intimating that quantity production of specific gear combinations is necessary to secure savings in the expense of cutting internal gearing proportioned according to the Williams system. From a purely money-saving consideration the *full* economic advantages of the Williams system—if operating advantages, decreased depreciation, etc., are ignored—are to be secured only in the manufacture of duplicate gear combinations in large numbers; such, for instance, as in the manufacture of motor-truck drives. This limitation exists in the case of any system of gearing, but to no more marked extent in the Williams, for gear combinations of assorted size and ratio can be cut more economically, if of the Williams type, than combinations designed according to any other system of gearing —even in small quantities.

The different degrees of internal gear tooth obliquity need be no greater than has become standard in the case of involute gears, but it is certain that the commercial introduction of the Williams system of internal gearing will bring about the employment of a much more extended range of tooth obliquity than has been attempted in the case of involute gearing. An alteration in the obliquity of Williams internal gear teeth is a simple matter, for simple and inexpensive cutters only are required to machine the internal gear teeth, as the comparatively long and expensive operation of generation does not have to be resorted to, as in the case of accurately cut involute gear teeth. The tooth spaces of Williams internal gears are rapidly gashed out and finished with precision by simple tools, easily maintained in accurate and effective condition. These cutters may be of the rotating or reciprocating type—milling-machine or shaping-machine tools—depending upon the clearance provided by the gear blank. If the gear is of the ring type, the speed of the milling process may be utilized, while if the teeth have to be cut with a reciprocating tool there is no reason why a simple form of fixture should not be provided so the shaping-machine ram can actuate several cutting tools at the same time and cut as many tooth spaces at one setting of the gear blank.

Cutting the Mating Pinion Teeth

In cutting the teeth of the mating pinion, the generating principle is employed, but as in the ordinary internal gear combination the pinion has only a comparatively small number of teeth the more complex operation is only a fraction of that entailed in generating the teeth for involute internal gearing, where the total number of teeth in both gear and pinion are so formed.

Another important consideration in connection with the relative costs of machining Williams and involute forms of internal gearing—one which carries considerable weight—is the fact that in the Williams system the minimum number of pinion teeth is not limited to 10 or 12, as in the case of pinions of the involute form, but to a much smaller number. Undercutting definitely limits the number of teeth in the involute system, but to no such marked extent in the Williams. A strong, efficient and entirely satisfactory Williams pinion can be made with only six teeth—even a lesser number—so that speed ratios may be secured with gears of the Williams type having only a fraction as many teeth as required for similar involute gear combinations. The reduction in cost of production due to this one fact is very marked, for quite obviously it costs much less to machine half as many teeth as are required for a given ratio in the involute system. The relative economy of the Williams system in this respect is even greater than represented by the direct proportion. The pinions, with their relatively small number of teeth, can be generated per tooth in the Williams system quite as cheaply—if not more so—than in the involute system, while the machining of the larger number of internal gear teeth is more cheaply performed per tooth in the Williams system than in the involute.

When only an occasional pinion is required, its teeth are generated—a simple machine for performing such operation having been designed—but if the gear combinations are manufactured in quantities, as is the case in the manufacture of virtually any standardized product, a further economy is to be realized by providing accurately formed milling or shaping cutters for machining the tooth spaces. These cutters are formed with accuracy by grinding wheels set at the obliquity and position of the internal gear tooth profile with which the pinion is to mesh, so that the cutting of the pinion teeth in quantities is resolved to a rapid and

simple milling or shaping operation with precisely formed tools and the longer and more expensive operation of generating the pinion teeth avoided.

PROFESSOR HAYES' REPLY.

Editor, *American Machinist:*

In the reply which Mr. Trautschold has so kindly made to my inquiries concerning some points in his article on "The Williams Internal Gear," published on page 255, he has cleared away most of the points raised, but he has also introduced some others which may be worthy of consideration. The first of the new points is, perhaps, irrelevant to the main discussion but it may as well be taken up in order. First, let it be said that there is no question raised as to the fact that the profile planes of the gear teeth will all be tangent to a single circle, or better, to a cylinder the axis of which coincides with the axis of the gear.

Mr. Trautschold has devoted the first paragraph of his reply to a demonstration of the foregoing fact and in this demonstration he states: "The profile planes of the teeth of an involute rack, if extended to infinity, would be tangent to a circle of zero diameter, or radius." Infinity is a peculiar place and it is hard to give a logical explanation of some of the things said to happen there. Let us now consider the profile planes of the Williams internal gear, which, as stated later in this same reply, make a constant angle with the opposite side of the tooth space. It is at once evident that any increase in the diameter of the gear must produce a proportionate increase in the diameter of the cylinder to which the profile planes are all tangent, and that if continued to the limiting case when the gear becomes a rack, the cylinder will have become infinite in diameter rather than to have suddenly dropped back to zero. This is, however, a purely academic point in the theory of limits.

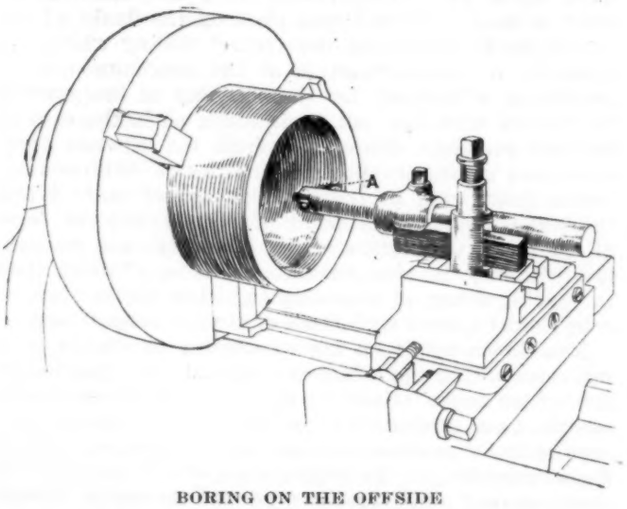
The reply makes it clear that by "the tooth space angle," as used in the original article, is meant the angle included between the two opposite sides of a space instead of, as has often been used in connection with gears, the angle subtended at the center of the gear by that portion of the pitch circle included in the space. This point will bear additional emphasis, as it is the key to the original description and clears away entirely the questions raised as to the excessive cost of manufacture. In the same paragraph it is stated that this tooth space angle "is definitely fixed" in size; in a later paragraph it is also stated that "the obliquity of the gear teeth, their depth and proportions can be so selected that the full length, or very nearly, of the usable path of point of contact may be utilized; this is a question of design"; and finally that "the different degrees of internal gear tooth obliquity need be no greater than has become standard in the case of involute gears . . . ." It would seem a fair inference, in spite of the seeming contradictions, that it is expected that one or two standard angles will be adopted but a fairly definite idea of the probable values of these angles would be of interest.

While it is very evident that the Williams system will materially increase the possible angle of action for internal gears, nevertheless, as any increase in the tooth space angle for the purpose of increasing the pinion tooth length and the angle of recess must at the same time weaken the pinion tooth at the root, the extent to which it is practicable to carry the recess action should be subjected to very careful examination. It may be as relevant here as anywhere to note that Mr. Trautschold, in commenting on the efficiency and wearing qualities, says of the Williams gear, "such concentration of wear as does occur will take place on the flanks of the pinion teeth, *destroying the contact* during which the obliquity in transmission is at the maximum and so developing a tendency for the efficiency of the gear to *improve with age*, ..." This immediately raises the point, why not cut away the faces of the teeth of the gear at the time of making them and so secure the increased efficiency at once? It would be an acknowledgment that the use of the full extent of the possible approach angle is undesirable because of the extreme obliquity, but if increased efficiency is obtained thereby it would pay in the end. This introduces another question of rather academic interest. Mr. Trautschold contends that the approach angle is not the same as it would be for gears of an involute system having the same obliquity as that at which the Williams gear commences action. If he will draw through the pitch point of his gears an obliquity line perpendicular to and intersecting the limiting radius *Os* of his Fig. 1, he will there establish the first point of contact for an involute system of the required obliquity. Of course, such an involute gear system would have an increased addendum for the internal gear, greater than for the Williams, a coarser pitch, and a short recess action—an undesirable combination, but it has the approach angle.

An Old Kink in Boring

BY ADAM HOMO

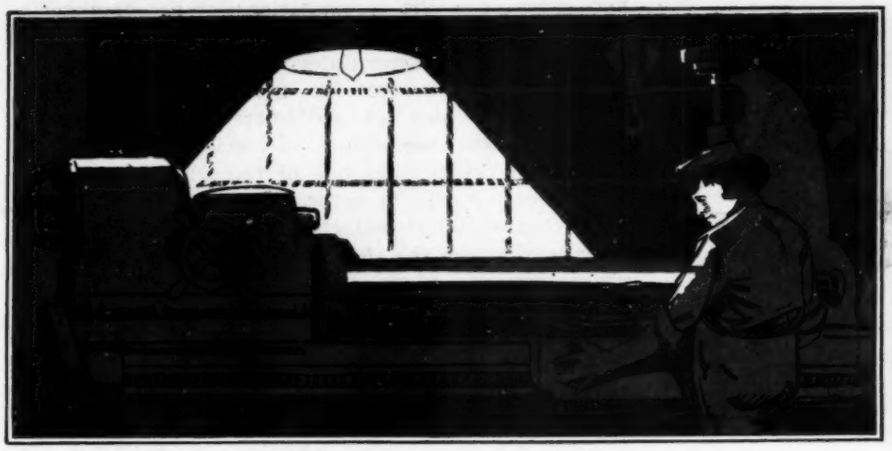
Trouble is sometimes experienced when boring out bushings or cylindrical pieces of large diameters in the lathe chuck, especially when they are too short to allow the use of a steadyrest, because of chattering of work due either to worn bearings or a too frail boring tool. In every case coming under my observation, I have advised cutting on the offside as shown at *A* in the



BORING ON THE OFFSIDE

sketch or else reversing the lathe and turning the tool over. The cut then helps to hold down the job and reduces the chatter. It is always best to do the entire boring on the offside. A heavier roughing cut can be taken and the work done much faster.

At one plant where I was employed recently the standard time on a certain job bored in the usual way was 16 hours. The general foreman, a man claiming a wide experience, was very skeptical of any better results when I suggested that the boring be done on the offside (the lathe not being equipped with reverse belt) and declared he had never seen it done that way. However, the job was done in this manner in 4 hours.



LIGHT, ELECTRICITY and The Shop
By
C. E. Clewell

Operation of Shop Motor Brushes and Contact Devices

This article treats of the brushes and the commutator of the shop motor as one of the means for determining whether it is operating properly. Notes are included on the common adjustment of the brushes and the brush holders of the motor and on the care of the commutator and the brushes. The advantages of one type of alternating-current motor are mentioned because of its freedom from any moving electrical contacts.

THE general use of electric motors for machine-tool operation makes it important for the shopman to know something about their operation under the conditions of everyday use. One of the ways to detect abnormal operation of the direct-current motor is to note the manner in which the brushes behave under various load conditions, and also to note the appearance of the commutator when the motor is at rest.

The operator should have some idea of the causes of sparking at the commutator and of the simple adjustments which are required to bring about normal operation. The purpose, therefore, in the following notes is to discuss briefly some of these practical aspects of the motor solely from the standpoint of the machine-tool operator.

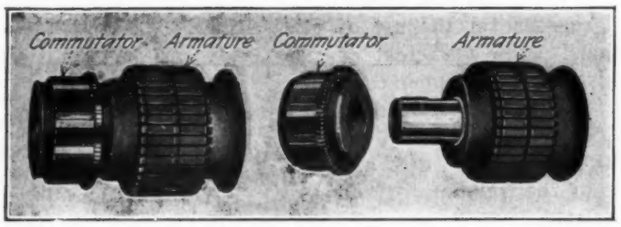


FIG. 1. (a) QUILL OF ARMATURE CORE AND ARMATURE WITH COMMUTATOR ATTACHED, (b) THE SAME ARMATURE BEFORE ATTACHING COMMUTATOR

The Commutator for Direct-Current Motors

The load current, which is drawn from supply circuits by a direct-current motor, is conducted to the windings of the armature through the brushes by way of the commutator. The brushes and the commutator thus form a connecting link between the supply circuit and the armature, and on this account must be capable electrically of carrying the full-load current.

The commutator and brushes also act as a means for transferring each given winding section of the armature successively from one polarity, which applies before the given section reaches the brush position, to the opposite polarity immediately after the given section passes the brush. In this interval of the transfer the current in the given armature section must be reduced from its full value to zero and brought up to the opposite value, so that it will be adapted to the new portion of the armature position toward which it is rotating.

To accomplish this the various sections or segments of the commutator must be insulated from each other and must be properly connected to the conductors or windings on the armature. The relative position of the commutator to the armature is shown in Fig. 1[1] (a) and (b). The complete unit with the commutator assembled on the quill of the armature core is shown in Fig. 1 (a), without the armature winding in place. In Fig. 1 (b), the commutator and the armature are shown separately. These views show the insulation between the commutator segments and they serve to show also the proximity of the commutator to the slots of the armature in which the windings are placed.

The contact between the outside circuit and the motor is furnished by the brush that is held firmly against the commutator by a spring, as in Fig. 2. The brush must be held in place by a holder in which it must be free to slide so as to allow for wear. Although the carbon brush shown is in mechanical contact with the inside surfaces of the brush holder this contact is not depended upon for the electrical conduction of the current into the brush, this being accomplished by the use of flexible wires fastened securely to the top of each brush and to the outside of the brush-holder frame by binding screws.

The quality of the carbon brush has a good deal to do with the successful operation of the motor, and the features of the brush which are classed as most commonly related to the motor in its ordinary running condition include its electrical resistance, its hardness and

[1]Figs. 1, 2 and 3 are due to the General Electric Co.; Figs. 4 and 5 to the Electric Controller and Manufacturing Co., and Fig. 6 to the Cutler-Hammer Manufacturing Co.

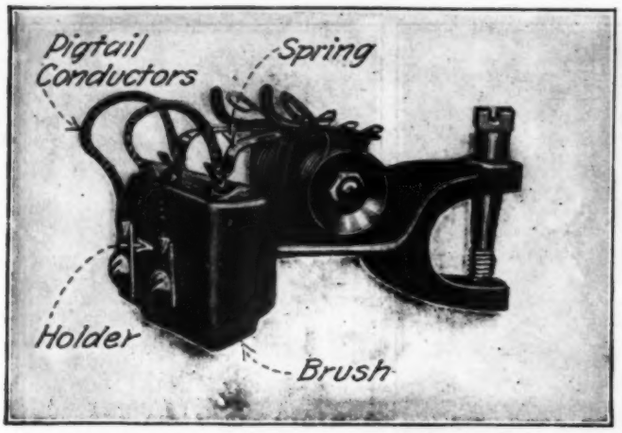


FIG. 2. A BRUSH HOLDER OF THE TWIN TYPE

abrasiveness, its coefficient of friction, the loss of voltage resulting at the point of its contact with the commutator and its ability to conduct heat[2].

By abrasiveness is meant the cutting action of the brush where it bears on the commutator. Hardness of the brush is not necessarily accompanied with corresponding abrasive action, since hard brushes are sometimes low in abrasiveness, and the reverse. While low electrical resistance of the brush is desirable in its ability to conduct the current into the motor with small loss, fairly high resistance is necessary for the successful performance of the function of the commutator in reversing the current in the given armature winding which is being transferred from one side of the brush to the next during the rotation of the armature. This, in fact, is one of the principal reasons for the use of carbon in such brushes. Obviously, the coefficient of friction between the carbon brush and the copper commutator must be low enough to prevent excessive frictional losses.

In some shop locations flying particles of dirt and even metal may fall on the face of the commutator and

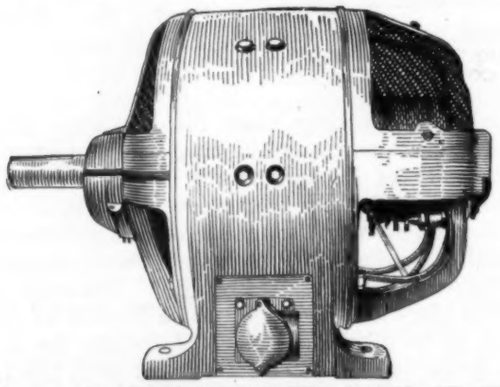


FIG. 3. AN ADJUSTABLE-SPEED MOTOR OF THE DIRECT-CURRENT TYPE

bridge across the insulation between adjacent segments, thus causing trouble in the motor operation. Furthermore the accumulation of fine particles of dirt on the face of the commutator may increase the abrasive action of the brushes.

This danger can be prevented or minimized by mounting the motor well above the operations which may cause such dirt accumulations, or by complete inclosure of the motor. Fig. 3 shows a scheme of partial protection for the commutator by a meshed-wire screen, which serves as a cover for intercepting large falling particles, but which does not interfere with ventilation as would be the case with a solid inclosure.

This point illustrates one of the advantages of the squirrel-cage induction motor, which has no commutator or moving electrical contacts of any kind and which is often used where the shop has alternating-current supply circuits, and where constant speed is sufficient from the operating standpoint. Motors of this type are particularly desirable where there is much lint in the air or where abrasive dust is present, as in textile mills or cement plants, it being assumed that the other operating characteristics are suitable for the requirements.

Irregularities in motor operation or abnormal conditions are often indicated by sparking between the brush and the commutator. When motors are installed, operated and looked after carefully sparking is negli-

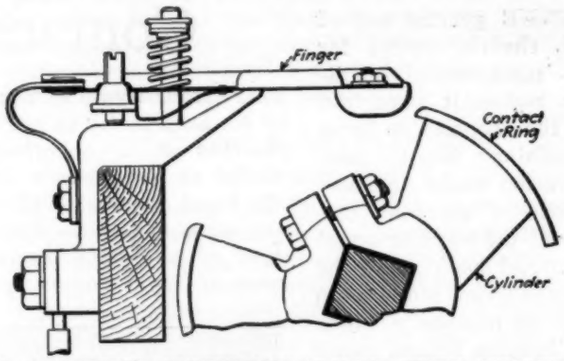


FIG. 4. FINGER CONSTRUCTION USED WITH ONE TYPE OF DRUM CONTROLLER

gible. If the operator finds that sparking does occur, any one of a number of reasons may cause the trouble, among which the following may be most likely[3]: (1) Excessive overload; (2) improper brush-holder adjustment; (3) poor brush contact; (4) rough commutator; (5) poor connection between the brushes and the holders, and (6) loose connection of the wires between the armature and the commutator bars.

These are merely suggestive of some of the things that cause sparking, but they are the more common difficulties met with in everyday operation, and further explanation of the remedy of some of these troubles will illustrate their nature and how they may be handled.

Motors equipped with commutating poles, as well as those especially constructed for reversing service, as in the operation of cranes and hoists, have brushes that are not adjustable, but are intended to operate at all times in one fixed position.

Where the brushes are adjustable the proper position of the brush is usually indicated by a suitable mark on the motor and on the movable-brush rigging. The idea is that if this position of the brushes obtains, the motor will operate throughout its normal range of load with little sparking and in either direction. Often motors of this class are used for operation in one direction only and it becomes necessary to adjust the brushes slightly

[2]Based on paper by E. H. Martindale, Trans. Am. Inst. of Elec. Eng., Vol. XXXIV, p. 659 (Part I), to which other references have been made.

[3]From installation, operation, care and repair of motors and generators, Instruction Book 5141 of the Westinghouse Electric and Manufacturing Co. Reference has also been made to this source in connection with brush adjustment and the care of commutators and brushes.

for overloads, in which case the brushes should be adjusted by moving the rocker-arm of the brush-holder frame so that the brushes move slowly backward against the direction in which the machine is running to such a new position that a small degree of sparking is noted at no load. Such a slight shift will usually result in

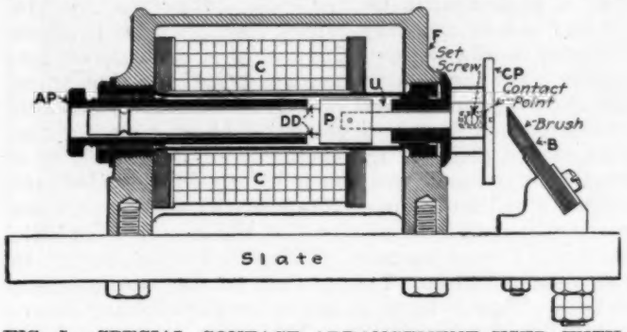


FIG. 5. SPECIAL CONTACT ARRANGEMENT USED WITH ONE TYPE OF CONTACTOR SWITCH

practically no sparking even under reasonable overloads. The amount of shift necessary is so slight that care must be taken not to carry the brushes too far back from the marked position. Too great a shift will result in excessive sparking.

Standard suggestions for the care of the commutator and its brushes are covered mainly by the maintenance of the commutator in a clean condition, by suitable adjustment of the brushes and by keeping a good contact surface on the brushes. Occasionally it is desirable to clean the contact surface of the commutator with a piece of canvas, which should itself be clean and without lint. A commutator requires very little lubrication, and where it may be desirable at times, no more than a very small quantity of oil should be put on the cleaning rag, or paraffine may be applied with only a little pressure by rubbing it on the commutator surface. The accumulation of grease, dirt and oil is to be avoided on the commutator and brushes.

If the commutator becomes roughened it should be smoothed down by sandpaper or sandstone, but not with emery paper or emery cloth. The application of sandpaper for this purpose requires some care, and in addition the smoothing action should be uniform around the entire surface. It is very important to clean the commutator thoroughly after the operation before the brushes are placed in position again. The surface of the brush which rests on the commutator should fit snugly throughout.

Among the difficulties that may cause sparking, as given above, poor brush contact is given as one of the common troubles. This may be due to dirt accumulations, which keep the bearing surface of the brush away from the commutator, or because the brushes do not move freely in the brush holders. If they are cleaned or ground so as to move more freely in the holder care should be exercised not to make them too loose. Finally the pressure of the spring, shown in Fig. 3, may not be sufficient to press the brush down firmly against the commutator, and in this event increased pressure of the spring is required.

In Fig. 4 a detailed diagram is shown of the finger construction of a drum controller, in which the contact finger slides upon the contact rings of the controller cylinder. Although the commutator has some different functions from that of this finger it is instructive to compare Fig. 4 with Fig. 2.

In Fig. 5 the contact point and the brush of a series switch for an automatic motor-starting panel are shown. Note particularly the method of holding the brush, and that the brush is laminated so as to insure good contact when the plunger is pressed up against it.

In like manner Fig. 6 shows the main parts of a magnetic lock-out switch for an automatic motor-starting controller, and here again the laminated brush is seen, and as an additional feature two auxiliary contacts are placed above the main contact point, the former breaking the circuit after the main contact has been opened. Note that the wear and tear due to arcing is thus taken up by the auxiliary contacts, which are easily renewable when required.

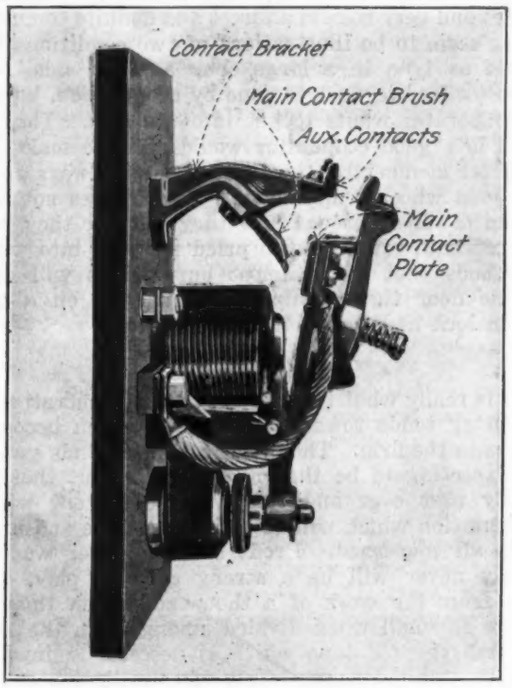


FIG. 6. SPECIAL CONTACT SCHEME EMPLOYED FOR AN AUTOMATIC CONTACTOR SWITCH

The foregoing notes have purposely dwelt upon the problem of contact devices as one of the points which the shop operator is likely to meet in the everyday handling of his motor-driven equipment, the purpose having been to suggest and discuss some of the interesting features commonly associated with them and thus to emphasize the value of giving them the attention which their importance to the other parts of the apparatus demands.

Fussiness or Democracy?

BY ENTROPY

When two young men start out in business together, say an auto-repair shop for example, they do so on a basis of mutual intention to put their shoulders to the wheel and vie with each other to handle as much work as possible. When they hire the third man to work for them they are almost inevitably disappointed. He wants to stop work when the whistle blows; he only wants to do what he was hired to do; and he is

quite fussy about doing any laboring work, no matter how good an example the partners set him. If, on the other hand, they succeed in getting a chap who puts his head and his muscle to work with them, they appreciate him and pay him all they can afford up to the time when he wants to be taken into the firm. Then they try to keep him out, but usually they lose him altogether. Up to the time when he asked to come in, they practically bargained with him every moment. They did what every one does when a man is first hired; they told him what they wanted him to do, what they would pay for it, and went over all the details that either he or they thought of. But after he was in the shop they still directed him by indirection rather than by orders. It was always, "If you'll do this, I'll do that," and very seldom a direct and definite command.

These seem to be illustrations of two conditions that are just as true in a large shop as in a small one. The most effective work is done by coöperation, but the good coöperator wants to get into the firm. The fact that he is a good coöperator would seem to make him eligible for membership, but that does not always appeal to the men who are already in. And it does not seem to make much difference how they got in; they seem to forget that. A man who pried his way into a firm by methods that were almost burglarious will often shut the door tight behind him and put on a combination lock and forget the combination.

Coöperation

This is really what the movement for democratization in industry tends toward; that is, the men becoming partners in the firm. The present moment finds some of them expecting to be the only partners, but that will probably pass over and they will be content with a representation which will be both reasonable and profitable to all concerned. Profit sharing never was and probably never will be a strong card to play. The profits from the work of a thousand or ten thousand men are so small when divided among them that it is not worth the red tape which is necessarily involved. The partnership idea, however, of consultation and cooperation is something that does appeal and which works where the whole organization is used to it. The military form of organization in which every man expects orders and expects to carry them out without question has probably gone by. It is no longer possible to hire a man for a job in Boston and suddenly tell him to report at the Chicago office next Monday. His home affairs are entitled to consideration; he may be married, he may have a mother who cannot move and who ties him to Boston. He is not as valuable in one sense as a man who is foot-free, but in another sense he is much more valuable because he is not nearly so apt to hear of a good job in San Francisco and leave the firm in the lurch to go there. Arbitrariness probably never paid, but whether it did or not it evidently is soon to become a thing of the past. Industrial democracy will probably settle down into a day-by-day or even an hour-by-hour bargaining about services to be rendered. This is rather the opposite to the trend toward collective bargaining, but not wholly inconsistent after all; for collective bargaining means that instead of spending the time to make individual bargains, the workmen will act as a body through representatives about the larger features of their jobs, while the smaller matters, instead of being settled by autocratic dictum of an irresponsible foreman, will be settled by coöperation.

Of course, this will rather leave out the men who are unable to coöperate, if there are any such. Too often, when an employer accuses a subordinate of being noncoöperative, he means that the man does not accept orders without question. The man who makes the accusation of lack of coöperative spirit is usually the one that needs to take lessons in coöperation. Any suggestion of true coöperation will be met by employers of the latter type with skepticism. They will declare that a shop cannot be run unless the men fear to disobey orders and they cannot imagine a shop where everyone works without the fear of discharge or discipline. Yet these same men will tell of the time when the shop was small and how everyone turned to and sweat to their bones to get out jobs on time for the sake of the pride of the shop. What is possible in a small shop is equally possible in a large shop divided into equally small units under foremen who are in the same position toward the workmen that the owner of the little shop was toward his men. This seems to be the key to the whole situation. Foremen are neither workmen nor owners. They have no incentive toward building an organization for the future. Their own tenure of office is not certain. They get no share in the profits. They are judged by the production of the moment. If they could be brought into the firm and given, and made to take, real responsibility, they would probably feel very differently toward both their employers and their subordinates; and where now they are inclined to let well enough alone, they would begin to insist on the opportunity to get the most out of their men through cooperation instead of trying to drive as so many do now.

Work of the British Engineering Standards Association

Though the British Engineering Standards Association has been in existence for many years, its full value was not realized until the stress of war made it absolutely necessary to secure the utmost coöperation among British manufacturers of various kinds. The growth of the work of this association since 1914 has been enormous and covers a wide variety of industries, which may be judged from the fact that it has a staff of several hundred people including a large number of technical experts.

Realizing the advantage to the mechanical industries of both countries standardizing as many of the details as seems advisable, the secretary of the association, C. Le Maiter, has been spending some time in this country with a view of securing the coöperation of our engineering associations. Through his efforts the various organizations in this country, including the Bureau of Standards, the Army, the Navy and the leading engineering societies, will all work through the Engineering Standards Committee, which will act as a clearing house and tend to prevent duplication of work and secure more effective coördination.

It is the practice of the British association to take up only such problems of standardization as are suggested by the industries themselves, and not to allow theoretical consideration of those not engaged in the industry to inaugurate means of standardization which may be neither warranted nor desirable.

Working along this line, the British association has been able to secure the hearty coöperation of the various industries and has been of great service in improving existing practices and methods. It is the desire of the British association to secure all the assistance possible from this country, particularly so far as it concerns machine tools and their equipment which are now being so widely used in the British shops.

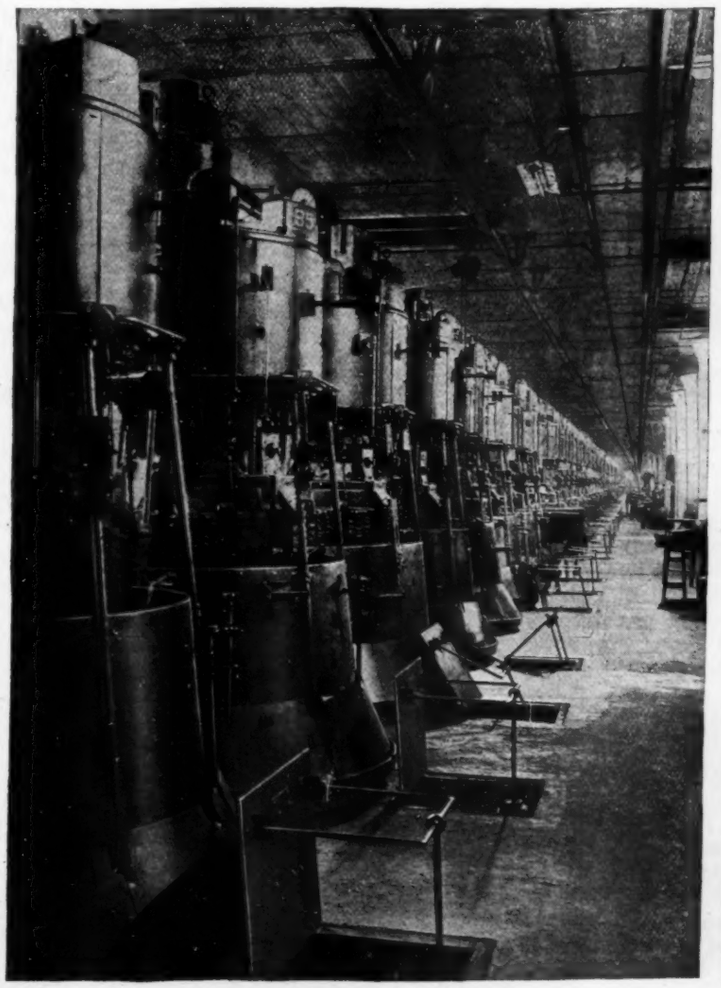
1, Work by the Carload

Work by the Carload Chips by the Ton

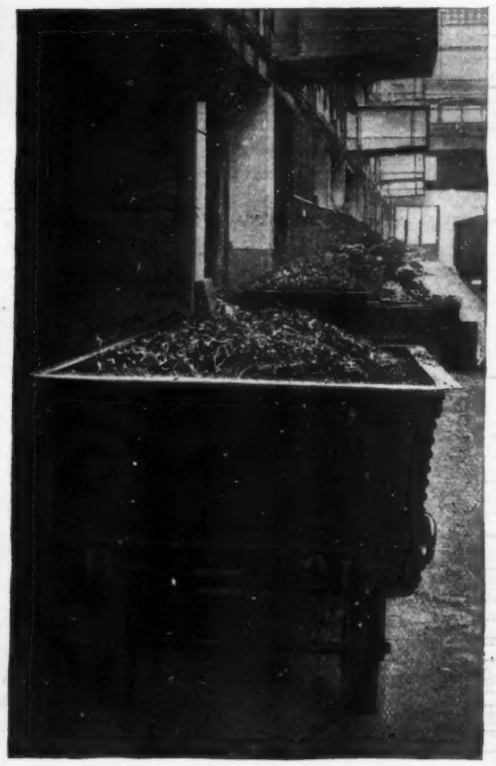
NOTHING, perhaps, is a better index of our progress in the design and use of machine tools than the amount of metal they are able to remove per hour or day. On this basis, the work of the Bullard Mult-Au-Matics in the Ford Motor Co., Detroit, Mich., shown herewith, stands at the forefront of modern shop practice.

These machines are located on platforms between railroad tracks so that forgings and castings can be readily brought to them and chips, in quantity, easily removed. The gang of machines shown contains 89 Mult-Au-Matics at work on a large variety of pieces, both iron castings and steel forgings. It is an impressive installation and it is to be regretted that it cannot be better illustrated by photographic reproduction. Incidentally, this number is being greatly increased.

The first view shows the way in which the work comes to the machines; the second is a row of the machines themselves, and, next, the truck loads of chips which must be removed very frequently. The average record of 14 machines of the group is 27,400 lb. of chips every 16 hours or very nearly a ton of turnings and borings per machine every two shifts, which is the working day.



2, Part of the Eighty-nine



3, Chips by the Ton

Electrically Heated Japanning Ovens*

By A. M. CLARK

An electrically heated oven is described for baking japan on various parts of typewriters. The method of use is explained and comparative tables show the economy and large capacity of electrically heated ovens.

THE Royal Typewriter Co., Hartford, Conn., bakes the finish on its typewriter parts in electrically heated ovens. In the following will be found a description of the process involved, and the results obtained from the use of japanning ovens equipped with electric heaters and control:

This installation consists of a battery of six ovens, four of which are 7 ft. 5 in. high, 7 ft. 1 in. deep, and 6 ft. 2 in. wide, while the other two are slightly smaller. Each oven has a connected load of 27 kw.

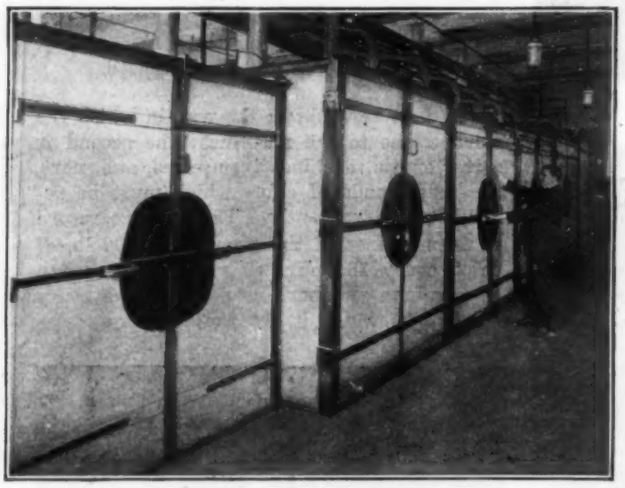


FIG. 1. BATTERY OF SIX ELECTRICALLY HEATED JAPANNING OVENS

Fig. 1 shows the battery of six ovens, and Fig. 2 the inside of one oven partly loaded.

The heating units take up very little space and run at a relatively low temperature. This low temperature, combined with the ventilation provided, practically eliminates the danger from explosions and fires. The ovens run almost without attention, as automatic control and a time clock insure the desired temperature and the throwing off of the current at a predetermined time.

Oven No. 1 is used for baking japan on the spacer bars of typewriters. These spacer bars are made of soft wood, and are given five coats of rubber japan. A temperature of 250 deg. F. is used for the first four bakes, while the last bake is run at a temperature of 275 deg. F.

The other five ovens are used for baking japan on various metal parts, on which the finish requires a more complicated system of baking and finishing. In the first oven the parts are baked for 5 hr. at 350 deg. F., after which they are rubbed down and baked in the second oven. They are then sprayed with a black baking japan and baked in the third oven for 5 hr. at 400 deg. F. After this, the parts are sanded and rubbed clean and the same operation is repeated in the fourth oven. They are then rubbed down and sprayed with black baking rubber japan and baked for 5 hr. at 400 deg. F.

These ovens have been in operation for more than four years and have proved very satisfactory.

The accompanying table shows the comparative capacity and cost of operation between two ovens, one equipped with gas and the other with electric-heating equipment. The second part of the table shows the comparative cost of gas and electricity.

TABLE SHOWING FUEL COSTS PER BAKE IN JAPAN OVENS

	Electricity	Gas
Capacity	300 frames	180 frames
Capacity	3288 lb.	2055 lb.
Fuel used per bake	123 kw.-hr.	1100 cu.ft.
Rate	$0.015 less 40%	$0.85–12%–$0.75
Cost per bake	$1.10	$0.825
Cost per frame	.00366	.00458
Cost per pound	.000334	.000401
Fuel Cost—Full Time		
Cost per day	$4.62	$5.78
Cost per month	120.12	150.15
Cost per year	1441.44	1801.80

This table shows that in our tests there is a considerable saving in the use of electrically heated ovens. It has also been found that electric heat proved advantageous in other ways, as with gas-heated ovens burning, underbaking, dust and variations in the heat, caused the loss of a certain percentage of bakes.

FIG. 2. INTERIOR OF ONE OF THE OVENS

*Abstract of a paper presented at the thirty-sixth general meeting of the American Electro-Chemical Society, Chicago, Ill. Sept. 22-26, 1919.

Industrial Activity in Europe

By E. S. CARMAN
Secretary and Chief Engineer, Cleveland Osborn Manufacturing Co., Cleveland, Ohio.

The statements which follow are those of a keen observer of both business conditions and of the men who make business possible. These observations should prove helpful to all who are studying the problem of rehabilitation and readjustment, not forgetting our own problems on this side of the water.

MUCH has been said and written regarding after-the-war industrial activity. Nearly all speakers and writers that I have knowledge of have given European industry a place of standing and attainment far higher and greater than pre-war times. I have had the great privilege of visiting England, France, Italy and Belgium's industrial plants and of coming in personal contact with their managing directors and engineers, and have seen and heard first hand just the conditions existing in various countries from four to six months after the signing of the armistice.

Arriving in England in early March, I spent two weeks studying the Englishman at home. I heard his complaint, his grumble, his expressed dissatisfaction with his government, with labor, with railroads, with the weather, in fact with everything and everybody—even Americans. His home was cold; exchange value of sterling made the American dollar standard; his food was poor and portions small; he had neither butter, sugar nor cream, and he feared that what he had President Wilson was going to give to the Huns. There was not much activity industrially, and labor as a whole threatened to strike on Sunday morning, Mar. 23. The demands of labor were the paramount talk of the day. The Englishman needed the holiday he had not had for five long years.

As one travels over the war-ridden countries, he can see the cattle quietly grazing on the hillsides, hear the birds singing sweetly, and in some of the countries you can even see children at their play. In Paris, one is surprised at the gaiety of the throng. In England, her beautiful countryside and the grumble of the Englishman are in evidence; and as you travel the battlefield, there seems to be a calmness and quietness that is so different than expected. All these are apparently unmindful of the holocaust of the past five years of war.

In France, the people seemed to be enjoying their new-found and unexpected freedom from the bitter fighting of the past five years. They seemed happy, content and ambitious to again take up the life of peace and happiness.

About Belgium

After visiting the Northwest battlefields I left France for a time, entering Belgium. It was here that one asked the question, "Can Belgium ever regain the industrial position she once held? Can she be a factor in the competition for the export trade of the world?"

We have heard and read of the wilful destruction of the cities and industrial plants of Belgium and northern France, but neither words nor pen can adequately convey to the mind the real conception of what the eyes can see and the heart can feel—for you must see with your eyes and hear with your ears, before you can conceive of the completeness of the devastation that was wrought.

The sentiment of the large portion of the Belgian population is very much in favor of America. This was noticeable at every village and city which I visited, and I especially call to mind visiting the City of Dinant with its great fortress—the city on which was based the last hopes of Belgium withstanding the German invasion of five years ago; the city that was laid low not by shell fire but by wilfull destruction. It was after visiting this city and being entertained by the burgomaster and others, that, in leaving in our automobile and swinging from their main thoroughfare across the River Meuse, a large crowd of school children, waving their handkerchiefs, cried, "Vive L'Amerique." It is unfortunate, however, that industrially the large portion of the population are not those who are buyers and, therefore, with the rates of exchange acting so much against America, it is doubtful as to what portion of Belgium's trade will come to us.

There is not much to be said regarding the labor conditions in Belgium. Upon inquiry, it was found that the workman did not seem to care to work and that where an attempt was made to stir him to industrial activity, strike after strike occurred; in many places the demands were immediately granted and then before accepting that which they were striking for, they would immediately ask for more and continue the strike.

In the City of Alost, the headquarters of the American Food Relief, which has now been taken over by the Belgian Government as their headquarters, I found the squares crowded with idle workmen and upon inquiry learned that men out of work were receiving 27 francs per week, and with this money, which was paid by the government, they purchased their supplies cheaply from the Belgian food relief stations and lived on this all week. There were at that time about 150,000 Belgians drawing this "idle" pay.

In contrast with this idleness, it is quite evident that the farms surrounding the cities required the help of every available man, and especially so since all their horses and oxen have been killed or taken away. One of the most pitiful sights which I saw was two men harnessed together drawing a heavy drag or harrow across the spaded ground.

Italy as a Manufacturer

Italy has been a consuming nation, importing large quantities of food, clothing, materials, and nearly all her iron and steel products of consumption; she has never been known as an industrial or manufacturing nation, but it is my understanding that her after-war aspiration is to become a producer instead of a consumer. She feels that the mechanical experience gained in war time should enable her to manufacture, and so she has continued and is producing several types of machine tools, hydro-electric power units, motors, etc.; as a whole they are crude-looking in design and poorly built.

It was my good fortune to visit many plants in all her large cities, excepting Venice, also a few of the navy yards and arsenals, including the largest; it was at this plant that I was shown the foundries, machine, pattern, boiler, plate and electric welding shops. These shops were furnished with only an average equipment,

and that did not seem to be producing an average output. This being the largest and best navy yard, I was beginning to wonder what the others would look like, when, much to my surprise, upon arriving at the shipyard and entering an inclosure, there lay before me on the ways, a submarine just about ready for launching; it was the last of an order of six; about 20 ft. in diameter and 200 ft. long.

We give the Italian credit for being an artist, and rightly so, but when we think of art we think of painting and sculpture, of palaces and song, but hardly do we expect to see such graceful lines and curves upon a submarine—an engine of destruction—built to fight. As I looked upon this thing of elegance and beauty—an artistic design with workmanship most skillful in the bending, shaping and riveting of the heavy plates—the American instinct began inquiring within, Was not this built to fight? Was not this built to win a war, and at a time when labor, capital and skill was in great demand? Why, then, the utter waste of labor, capital and skill necessary to fashion these heavy plates in such an artistic manner? Would not a more simple design accomplish the same work?

What position will Italy hold in the after-war struggle for commercial supremacy? Can she put into articles for general world-wide consumption all the laborious skill that she now puts in her works of art? And can she put into her products that exceptional amount of labor which she puts in the construction of her public works? I recall that while passing in a train I observed that a winding river in the bottom of a valley was being straightened, the cut being perhaps a mile long and the section which was being excavated was approximately 50 ft. wide by 8 ft. deep; and I am sure that you will find it hard to believe, when I say that all this vast amount of earth was being removed by spade and wheelbarrow methods.

As one travels throughout Italy, it becomes at once apparent that the business and home life of the Italians is one of ease and primitive in manner and habits; there are not to be found the many conveniences, and in fact the necessities of the American home and office; mechanical appliances in the every-day life are unknown. Labor is plentiful and cheap. Yet when output and cost is compared with ours, their costs will doubtless be much higher than ours.

Before Italy can export she must consume, and to teach her people to consume requires the changing of customs as old as history itself—a great task indeed.

The Conditions in France

In France, the conditions are quite different. France has a people whose habits are advanced, and her workmen know how to and can produce a day's work for a day's pay. There seems to be a willingness on the part of the workmen.

It was my privilege to be the first American civilian to inspect the greatly enlarged works of Schneider & Co., at Le Creusot. This great plant, which was responsible for the furnishing of much of France's war weapons, is now at work building instruments of peace, and preparation is now being made to convert still more of its many shops to the manufacture of useful peace-time machinery.

France is busily at work now, but France has years of work ahead to rebuild, repair and re-establish her industries, and that too with over three million of her best and most skillful workers either dead or disabled. Can France give attention to world-wide trade? Not yet.

And now, what about England? Yes, England has all that is necessary in the way of equipment to have and to hold the world's trade, except willing labor. England's labor will not work, regardless of the rate of pay; the day's output is restricted and retarded.

Her plants are not busy. Her labor is unemployed. Her masters are indifferent and I fear in many instances unconscious of the storm that will sooner or later break in great fury. We must look further back than the near past before we can begin to suggest the cause for all this present unrest. Europe's age-old curse—man and master, snobbery and hatred—is at the bottom of all her troubles. She does not and will not recognize that all men have an inalienable right to earn a livelihood and pursue the paths of peaceful, honest and happy living. Many of the masters of industry are autocratic, as are also the masters of labor. They are continually striving one with the other.

Can England be a factor in the race for world-wide commercial supremacy? Well, the question is a hard one to answer and I believe from observation we shall have plenty of time to wait for a reply. England has troubles of her own.

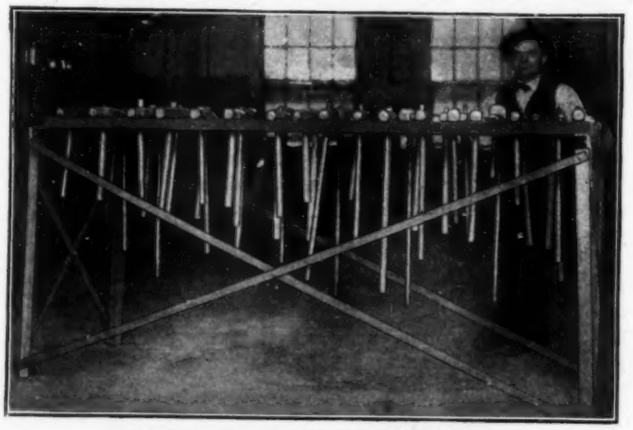
And last but not least, what about America? Well, I say: Go, America, and reap that which you have sown. Go, possess the world marts and with you take that blessed air of freedom and good will, of honesty and square dealing. Go, but not alone to possess the trade that you merit, but to break down and smash that barrier of class distinction—the cause of all war. Go, show them all men can be men regardless of their birth.

The world awaits our coming; it is tired of war, of all the pomp and display, the petty jealousies, the unfair methods in business in every-day life.

Portable Rack for Iron Worker's Tools

By George F. Paul

In storerooms where tools for blacksmiths, boilermakers, etc. are kept, the usual method is to put them in barrels so that a lot of them must be pawed over before the one wanted can be found. The rack shown in the illustration has been made to hold a stock of



PORTABLE RACK FOR SLEDGES

sledges, though similar racks can be made to hold punches, rivets sets, flatters and a variety of other tools used by iron workers. As may be seen, the heads of the sledges are all open to view; and as they are all within reach from either side of the rack, any one that is wanted can easily be recognized and taken out.

This rack is made of light angle iron and braced with flat bar iron and the cost of making it was little more than the price of one of the sledges it contains.

Exhaust Hoods for Grinding Machines

By E. E. SNOW

Exhaust hoods are at once a nuisance and a necessity. In some states they are required by law upon all grinding wheels above 3 in. in diameter, and in all shops good judgment dictates that they shall be installed in the interests of preservation of valuable machinery. This article shows how hoods were installed in a toolroom in such a manner as to interfere as little as possible with the operation of the machines.

WHERE grinding machines are used in a factory on production work, it is not difficult to install an exhaust system and the laws of many states demand them on all grinding wheels 3 in. in diameter and over. In the toolroom where the machines are called upon to cover a great variety of work, necessitating frequent changes of wheel and position of the work, it appears to be generally assumed that an exhaust system is impractical because of its lack of flexibility.

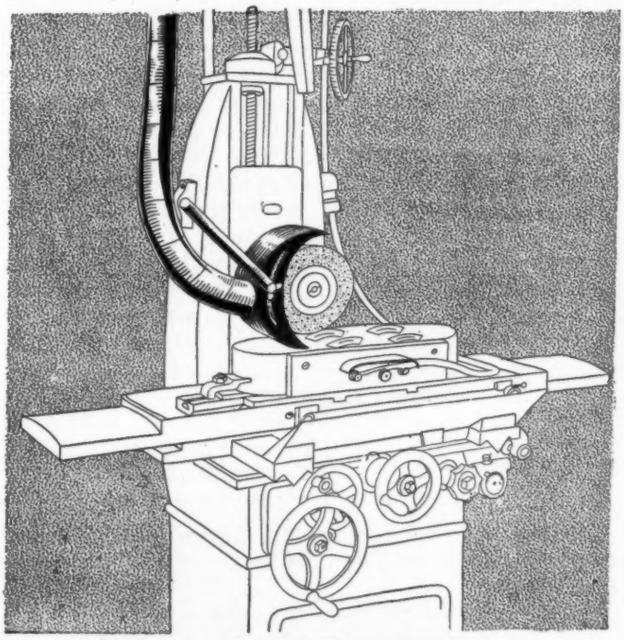


FIG. 1. HOOD ATTACHED TO COLUMN

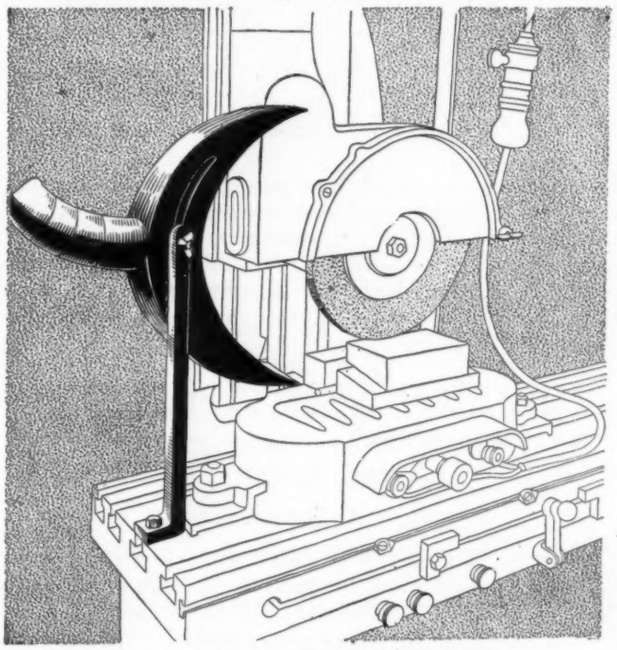


FIG. 2. HOOD ATTACHED TO TABLE

During the war the problem of eliminating the objectionable clouds of dust came up in a toolroom having some 30 grinding machines, including surface, cutter grinding, and universal, of different makes, as well as plain grindstones. All of these with the exception of the universal operated dry at all times, and the latter were frequently run without water. Because of the lack of adjustment of the usual form of exhaust hoods and piping, it had been decided that it was impossible to eliminate the dust.

Later the following plan was suggested and finally installed. Since the machines were in two rows with a center aisle, two lines of No. 20 gage galvanized steel pipe were run down the room immediately over them. At each machine a branch 3 in. in diameter was run off the main pipe and the latter reduced in size as it ran down the room so that its cross-section remained equal to the combined areas of all the branches entering it up to any given point.

The branches were provided with gates. From the end of these gates ran a length of 3-in. galvanized flexible metallic hose. This hose cost 70 cents per ft. and, while not absolutely air-tight, was as serviceable as the more expensive air-tight hose. To the free end of the hose was soldered a nipple or thimble. The flexible hose allowed the hood to be swung into any position and was sufficiently stiff to cause it to maintain any curve without throwing weight upon the hood support.

The hoods were of several designs. On the surface grinding machines the hoods were all alike, the variation being in the method of supporting them. In Fig. 1 a bracket was bolted to the machine and a bent rod, held with a setscrew and provided at its outer end with a bolt and wingnut, supported the hood by means of a slotted plate fastened to the latter. The hood could thus be swung about the wheel and fastened in any desired position. The same shape of hood was used at times by fastening a rod to the machine table by means of a bolt in one of the slots. This was preferred by many of the toolmakers as is shown in Fig. 2.

On the cutter grinding machines of the Cincinnati type the same hood was tried but was not entirely a success. A plain hood, as appears in Fig. 3, was placed over the wheel some 6 in. from the top. This collected all the floating grit; the heavier particles which settled on the machine being cleaned up at the end of the day.

The plain cutter and reamer grinding machines were fitted with hoods similar to those on the surface grinding machines. The universals were run wet most of the time, but it was found that the most successful method of handling the dust, when dry grinding, was to place the open end of the hose below the wheel without the employment of a hood.

The average toolmaker will quickly see methods of adapting this system to practically all forms of grinding machines. Some may wonder why a hood along the lines of the usual guard was not used; such a hood

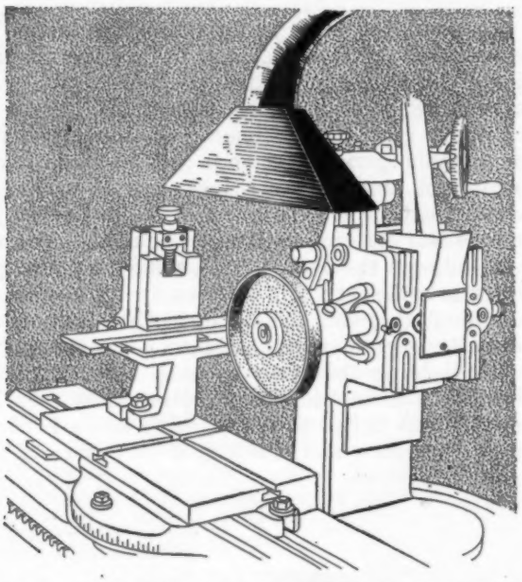


FIG. 3. HOOD FOR CUTTER GRINDING MACHINES

was tried out and found to be unsatisfactory where frequent wheel changes were necessary.

At the end of each day the men removed the hoods and by passing the hose over their machines removed practically all of the dust that accumulated. This prolongs the life of the machinery, and alone makes the system worth while.

High-Grade Machines, From the Machine-Tool Designer's Standpoint

By P. A. FREDERICKS

The term "high grade" is relative and in making comparisons the field must be limited. A high-grade bolt-cutter construction would not do at all for a high-grade milling machine; therefore, first consideration must be given to the work or product expected.

To some minds, consideration of the work would exclude all machines not working on a high-grade product —that is to say, on a product which does not call for refinement and accuracy—but to the writer's mind this is not the correct viewpoint.

The second consideration is that of the results which can be obtained from the tool, and this, too, is relative, requiring comparison with results from other tools built for the same purpose. For example: the highest-grade milling machine built 20 years ago would not compare favorably (even if completely restored) with the high-grade tools of today and those of today will certainly be relegated to second grade in another 20 years.

This second consideration can be subdivided as follows: Accuracy of production; quantity of production; reliability or permanence of production. Of these, the first might easily have been duplicated in the machines of 20 years ago. The second and third, however, imply an up-to-date design embodying materials, mechanisms, proportions and workmanship which a combination of all past experience to date, with similar machines, has proved best for the purpose. They also imply that the design must embody, all the time, power and labor-saving features proved by experience to be truly valuable on a machine of the type considered in that they increase accuracy, quantity of product, or reliability in greater proportion than they increase expense—expense being in this case a combination of labor, first cost and upkeep.

The next point to be considered is appearance, which, though relatively unimportant in machine tools, would certainly be the deciding factor in case all other items were equal, and it cannot therefore be excluded. Appearance demands consideration of pleasing outlines for the construction required, pleasing and lasting finish on parts coated or painted, and a matching up of units and brackets to their pads; together with a suitable rounding of corners, fillets, bolt heads and ends, and projecting shafts and bushings.

The final item is relative cost, which must be considered as a combination of first cost (price paid plus freight and installing); operating expense (labor, rental or floor space, power and supplies); upkeep or repairs and depreciation.

In other words, considering, first, the class of requirements of the work, and, second, the results obtained (accuracy and quantity of product and reliability and permanence of machine), the highest grade of machine tool would be the one which obtained the maximum of desirability in respect to the above items at the least outlay of first cost, operating expense and upkeep.

It will now easily be seen where the designer comes in. If the above are the requirements of a high-grade machine tool, all one has to do to become a high-grade machine-tool designer is to learn to design machines answering the above description. He will then be entitled to a salary, besides the dollar mentioned when he assigns the patents, and also to refer to himself and be known by his neighbors as a draftsman.

Finding a Center by Trigonometry

BY GUSTAF E. NORDSTROM

Another way of solving Mr. Moore's problem, as stated on page 584 of Vol. 51 of the *American Machinist*, is as follows:

Using the same notation as in the original figure

$$\cos A = \frac{7.875}{9} = 0.875$$

$$\cos C = \frac{4.125}{6} = 0.6875$$

$$A = 28^\circ\ 57'\ 22''$$

$$C = 46^\circ\ 34'\ 3''$$

$$A + C = 75^\circ\ 31'\ 25''$$

$$R = \frac{6}{\sin (A + C)} = 6.1967$$

$$X = \frac{6}{\tan (A + C)} = 1.5490$$

[The following rules will help out the man whose geometry is a little rusty, in following this proof: As the base of any triangle is to the sum of the sides, so is the difference of the sides to the difference of the divisions of the base made by drawing the perpendicular. If an angle at the circumference of a circle, between two chords, is subtended by the same arc as an angle at the center, between two radii, the angle at the circumference is half the angle at the center.—ED.]

Machining Problems Solved in Gun Making—I

EDITORIAL CORRESPONDENCE

After the armistice was signed activities in munition-making industries have largely ceased, but the average reader may still profit by a study of the machining operations used in gun manufacture. This is particularly true of the methods that were devised to obtain the requisite accuracy in the heavy pieces of ordnance, and these tooling processes should be of as much interest to the machinist in the future as any other modern methods of production.

WHEN the Northwestern Ordnance Co., Madison, Wis., was formed in the summer of 1917 by some of the executive officers of the Gisholt Machine Co., the site of the present gun plant was a plot of vacant ground adjoining the Gisholt factory, but the urgency of the gun-building program spurred on the construction of the works so that they were ready and waiting for gun forgings before the end of the year. The main building is 327 x 316 ft. and is in the form of a square with main crane bays running around the four sides of the building. The crane runways overlap so that heavy pieces may be readily transferred from one to the next in the series, and the majority of the heavy machinery is located beneath these main craneways. The machines for the production of the lighter gun parts are situated in aisles extending lengthwise through the center of the building, together with the toolroom, inspection coops and finished-parts storage. The offices, toilets, rest rooms and heat-treating and tool-dressing rooms are located in wings extending from the side of the main building.

The gun which is built here is the 4.7-in. rifle model of 1906, which was described on pages 519 and 649, Vol. 48, of the *American Machinist*.

After the tube is received as a roughly turned and bored forging, Fig. 1, it is placed in a Hendey lathe and telltaled throughout its length both inside and outside and through the bore to insure that it will clean up at all points. A double carriage lathe, Fig 2, is used, which enables the operator to turn two of the steadyrest spots at one time.

The boring is done in a Lodge & Shipley gun-boring lathe, Fig. 3, after the bore has been opened up for a length of from 3 in. to 4 in. for the full diameter of the cutter blades on the boring bar. The tool used for the opening-up operation is shown in Fig. 4, and is mounted directly on the end of the boring bar and keyed on in the same manner that the boring tools are attached. The small cutting tool *A* carried on the end of the bar *B* is firmly supported by the heavy bar extending from the main body of the tool. The slight adjustments necessary to obtain the correct diameter are readily accomplished by turning the handwheel *C* which operates the feed screw *D*.

After the first rough-bore of the tube its outside is rough- and finish-turned in a Bridgeford lathe, Fig. 5, which has a profile attachment for the tapered portions. In

FIG. 2. TURNING STEADYREST SPOTS ON TUBE

FIG. 1. ROUGH-TURNED AND BORED GUN-TUBE FORGING

ARMY ORDNANCE NEWS

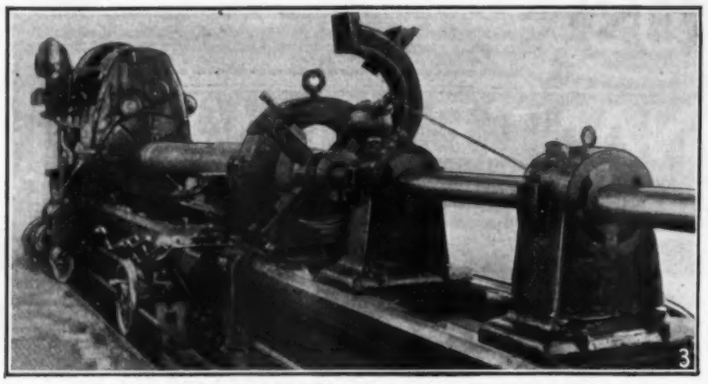


FIG. 3. ROUGH-BORING TUBE IN A GUN-BORING LATHE

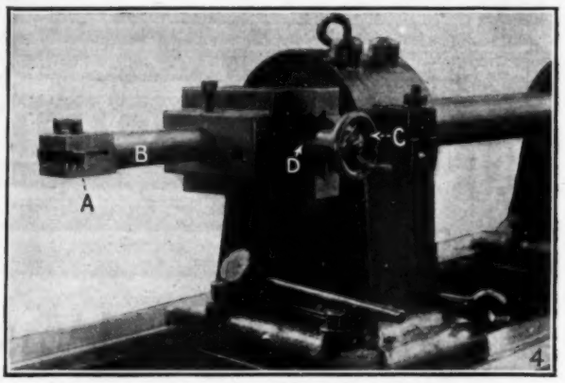


FIG. 4. TOOL FOR OPENING HOLE FOR BORING REAMER

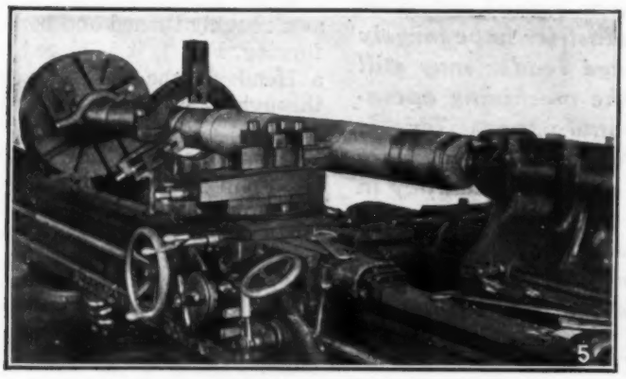


FIG. 5. TURNING OUTSIDE OF TUBE

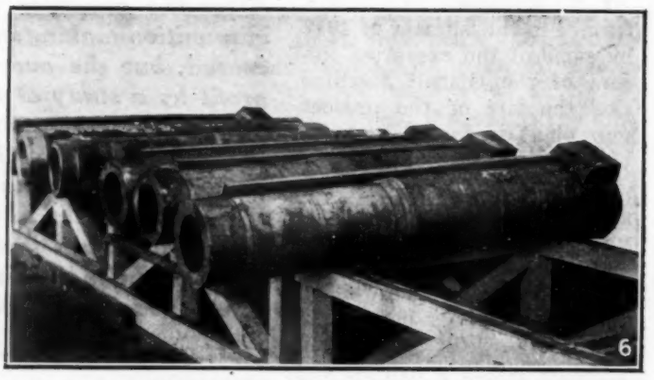


FIG. 6. ROUGH-TURNED AND BORED JACKET FORGINGS

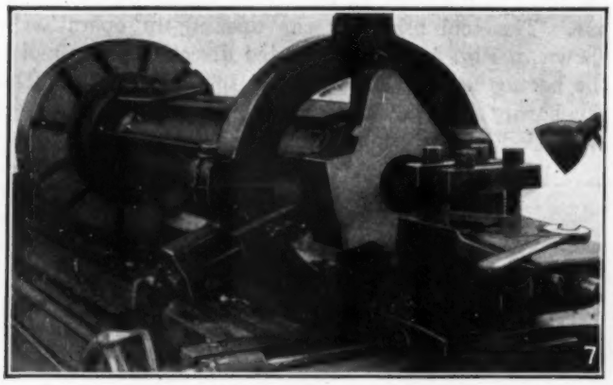


FIG. 7. OPENING UP BREECH END OF JACKET

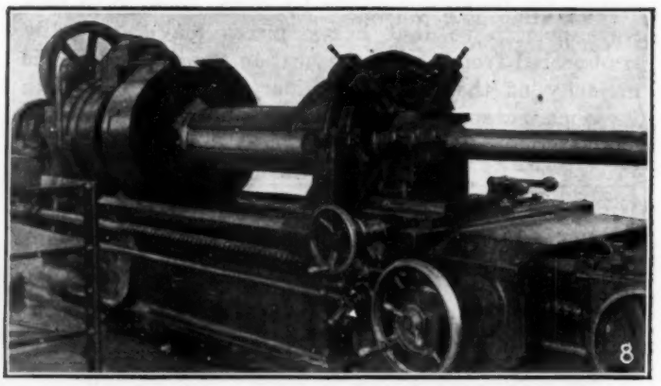


FIG. 8. FINISH-BORING OPERATION ON JACKET

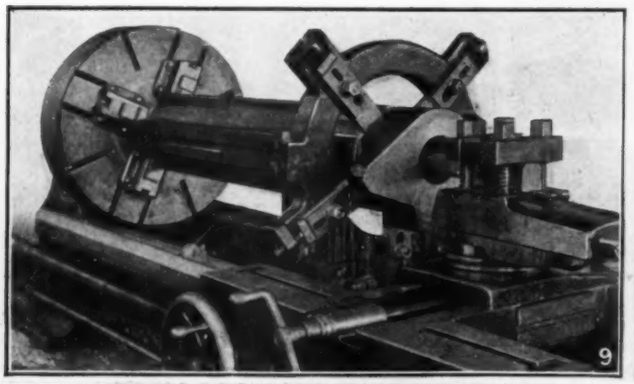


FIG. 9. CUTTING THE TUBE-LOCKING THREADS IN JACKET BORE

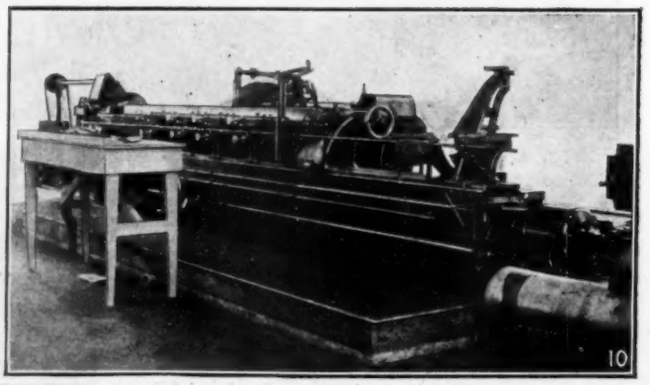


FIG. 10. GRINDING THE SHRINKAGE SURFACE

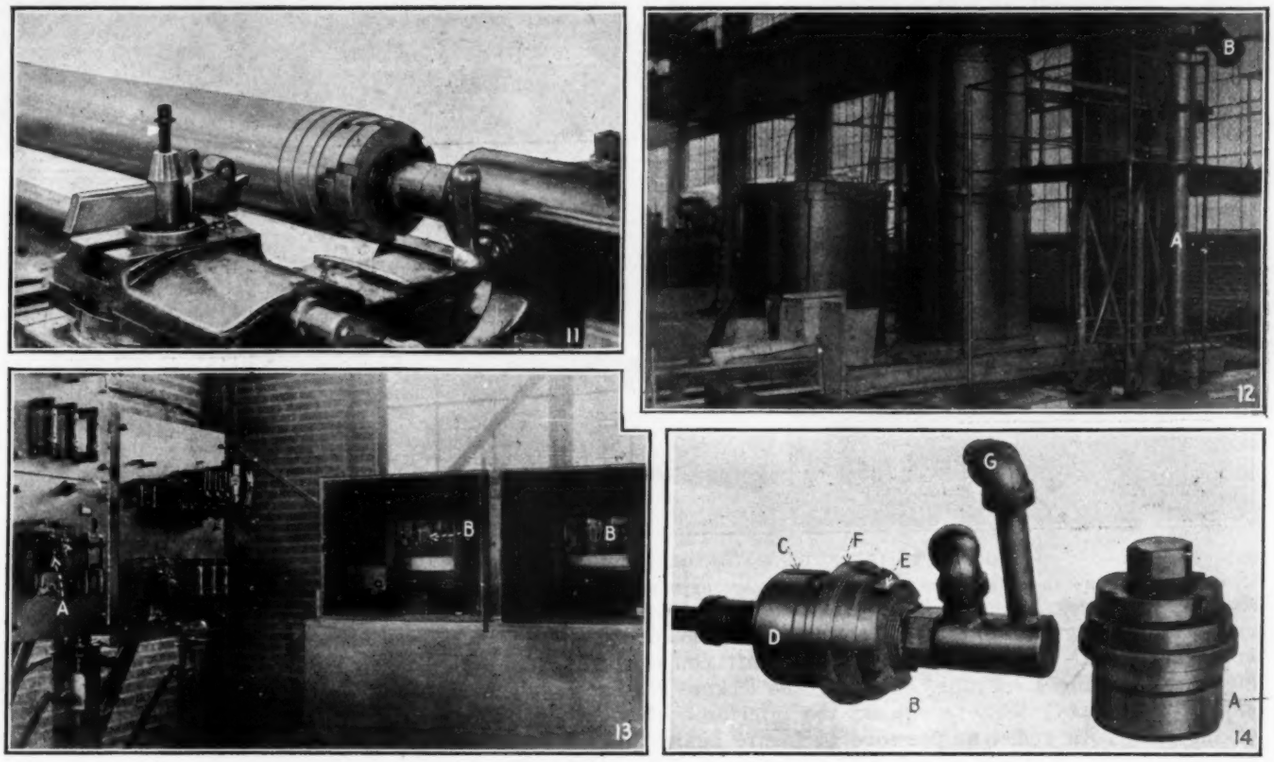
ARMY ORDNANCE NEWS

the meantime the rough forging for the jacket, Fig. 6, has been passing through a similar series of operations of spot-turning for steadyrests and opening up the bore at the breech end, Fig. 7. It is then mounted in a heavy boring lathe built by the Gisholt Machine Co., Fig. 8, for the jacket-boring operation. After the finish-boring the thread for the tube is cut, Fig. 9, and the jacket is then ready for star-gaging to make the shrinkage drawings for grinding the outside of the tube.

The operation for star-gaging and making the shrinkage drawings is very much like the methods used for this operation on similar types of guns and so need not be described here. The tube is ground to meet the star-gaging dimensions in the 20 x 220-in. Landis horizontal grinding machine, Fig. 10. After the completion of the grinding, the thread is cut on the tubes, Fig. 11, to match the dimensions given by gaging the threads on the inside bore of the jacket.

The operations of shrinking on the jacket and other parts of this gun are similar to the standard practice in other gun shops. Allowance must be made to obtain a certain amount of shrinkage pressure of the jacket on the tube, the bore of the former being sufficiently under the size of the outside diameter of the latter to insure a definite amount of pressure.

A neat and business-like arrangement is made of the heating furnaces and shrinking pits, Fig. 12, which are located above ground; the electrically heated furnaces were built by the General Electric Co. The higher furnace for heating the jackets is long enough to contain the full length of a tube if it should ever be necessary to heat one, and the shorter is used for heating the locking hoops and front clip forgings. The heat of these furnaces comes from a series of electric-resistance coils that surround the inside walls. The heating units are controlled from the switchboard *A*, Fig. 13, and this control is entirely automatic, being operated by the Leeds & Northrup automatic recording pyrometer sets shown at *B*, which control the temperature of the heating furnace within a range of about 5 deg. F. The temperature used for shrinking the jackets is approximately 800 deg., and when the jackets are inserted cold into a hot furnace it requires about 7 hours to bring them up to temperature.



FIGS. 11 TO 14. CUTTING THREADS, AND SHRINKAGE-DEPARTMENT METHODS AND EQUIPMENT

Fig. 11—Cutting the locking threads on tube. Fig. 12—Electrically heated furnaces and shrinking pits and platforms. Fig. 13—Pyrometer temperature-controlling devices. Fig. 14—Sealing plugs for water cooling of tube.

The shrinking operation is interesting to watch, as to complete the job in the specified three minutes the work must be done with everyone on the jump. Everything is in readiness before the furnace is opened for the removal of the jacket, as will be observed in Fig. 12, where the tube *A* is standing in place ready for handling as soon as the jacket is placed in the shrinking-pit frame.

The tube must be kept cool with water applied internally until the jacket has cooled sufficiently to approximate the temperature of the tube. No water must leak from the tube on the jacket, and the device used to fit the tube for this work, Fig. 14, shows at *A* the plug used for making the lower end watertight, and at *B* a similar plug which serves as a water outlet at the upper end of the tube.

The method of insertion of these two plugs is identi-

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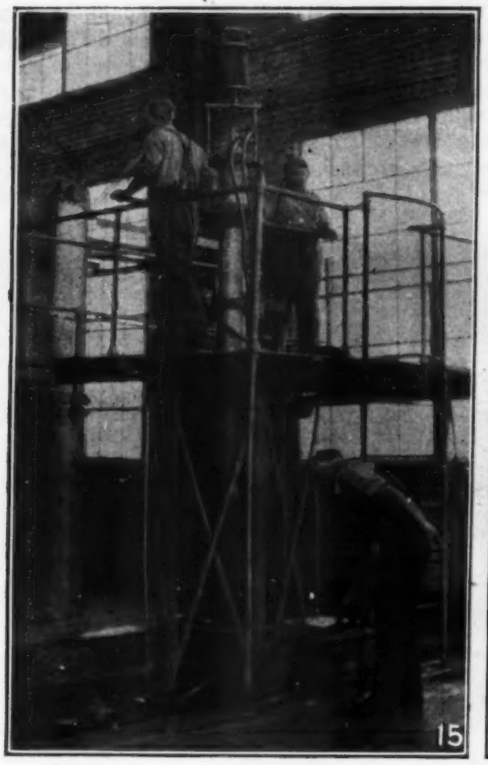
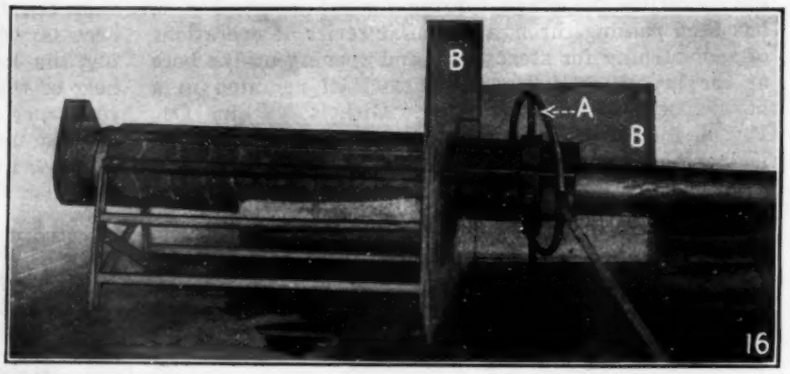
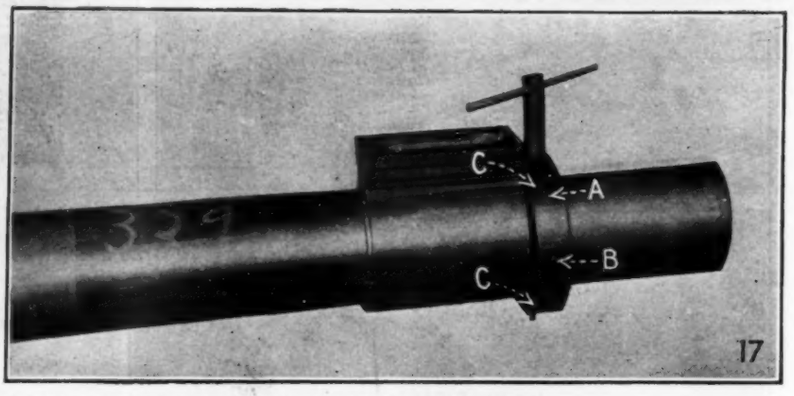






FIGS. 15 TO 17. SHRINKAGE-DEPARTMENT METHODS AND EQUIPMENT

Fig. 15—Shrinking the tube in the jacket. Fig. 16—Arrangement for shrinking locking hoop. Fig. 17—Device for holding front clip.

cal. The end *C* goes into the tube as far as the shoulder; the sides *D* are quarter sections of soft copper fitted on a sliding steel cone. Turning the locknut *E*, expands the copper sections against the interior walls of the tube with sufficient pressure to insure against any possibility of slipping out. The workman then turns the nut *F*, which forces a lead gasket on the shoulder tightly against the end of the tube. The upper plug *B* carries two pipe connections to which water hoses are coupled; of these one pipe connection *G* connects with a length of pipe on the inside of the tube and conveys the incoming water to its bottom, and the other is for flow-off of the cooling water.

As a preliminary to shrinking, the tube is stood vertically in the shrinking platform, as shown, and its shrinkage surface is smeared with graphite grease. The spring lifting attachment *B*, Fig. 12, is used to carry the load of the tube and to provide play during the period when the threads are being turned down in the jackets, which compensates for the impossibility of adjusting the lowering feed of the crane to maintain an absolutely uniform position. There is a white indicating mark on the side of this device which shows the craneman when there is approximately 200 lb. downward pressure on the thread, and he attempts to hold the indicator at this point.

After removal of the hot jacket from the heating pit it is lowered into the center of the shrinkage platform and held in a vertical position by quick-acting adjusting screws. The tube is then lifted and swung into line with the center of the jacket bore. To get this alignment without losing any time in signaling the craneman, two devices have been placed on the crane and runway which might be of service to any shop where the crane is constantly being aligned in certain fixed positions. One consists of two white pointers, one on the crane and the other on the runway, which the craneman sets one above the other. For alignment of the forward and back motion of the carriage an endless cable has been attached to this and extended over pulleys at each end of the bridge. This cable runs back and forth with the movement of the carriage and a white spot placed on it acts as an indicator of the correct position.

When it is in line the tube is lowered until the threaded portion catches in the jacket; two men screw it into place with levers, Fig. 15, and the foreman immediately turns on the cooling water.

The locking hoop is shrunk into place, Fig. 16, with the gun in a horizontal position, and as this part is light enough to be handled by two men it is easily slipped over the tube and screwed into place. The perforated circular ring of pipe *A* is used for providing a spray of water for cooling and the sheet-metal shield *B* is attached to the framework of the gun-supporting trestle to keep the floor dry. In Fig 17 is shown the method of shrinking the front clip which is slipped over the muzzle end of the gun until it comes in place against a small shoulder left on its shrinkage surface. Before it can shrink up tight the collar *A* is brought up against it and fastened to the tube by means of four setscrews *B*. The small taper wedges are driven into the slots *C*, which insure that the clip will hold tightly against the shoulder while shrinking.

The Foster Line of Hand Screw Machines

This article describes the features embodied in a line of screw machines built in five sizes by a prominent builder. Two of the machines, the smallest and the largest, are illustrated as being indicative of their general character. These machines are all susceptible to many changes and modifications to suit individual customers.

THE Foster Machine Co., of Elkhart, Ind., has recently designed a complete line of hand screw machines embracing five sizes, ranging from $\frac{7}{16}$- to $2\frac{9}{16}$-in. capacities.

Fig. 1 shows the smallest and Fig. 2 the largest of these machines. Taken as a whole, the machines do not represent any radical departure from established practice but are built upon sound principles of machine design and have incorporated in them some of the best features found in other makes of screw machines.

It is claimed that the power and rigidity provided are in excess of the requirements made necessary by the latest developments of high-speed steel and stellite.

The unit principle of design has been carried out throughout the entire line of machines and each individual machine is assembled from a number of separate units built and kept in stock. This means a considerable amount of flexibility in meeting the require-

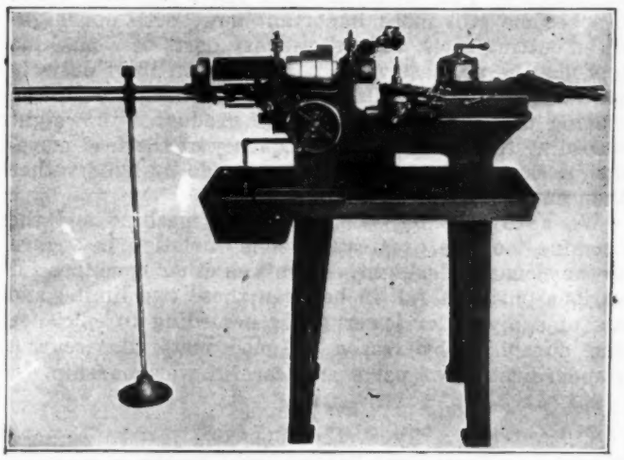


FIG. 1. FOSTER NO. 0 SCREW MACHINE WITH COMPOUND REST

ments of the individual customer. Three different styles of cutoff units: the lever feed cutoff, hand screw-feed cutoff and power-feed cutoff are being built. These are interchangeable and either one can be furnished as required. The power feed to the turret is a separate unit and a machine can therefore be built either with or without power feed to the turret slide. The automatic chuck and bar feed are independent units and can be furnished or not as required.

The No. 0 and No. 1 machines, which are of $\frac{7}{16}$- and $1\frac{3}{16}$-in. bar capacity respectively, are designed for high spindle speed and sensitiveness of operation, so essential in machines of small bar capacity. They are built in the three-step-cone pulley, plain-head type only. The turret slide, which is operated by a hand lever, has an effective longitudinal movement of 3 in. for the No. 0 machine and 5 in. for the No. 1 machine. The No. 0 machine can be equipped with a compound rest, which is interchangeable with the lever-feed cutoff ordinarily furnished.

The No. 3 machine, the bar capacity of which is $1\frac{5}{16}$ in., is built in both the plain-head and friction-head types. The No. 5 and No. 7 machines of $1\frac{13}{16}$- and $2\frac{7}{16}$-in. bar capacity respectively are built in the friction-head type only. The large-diameter cone pulley and the powerful friction are said to provide more than ample power for the heaviest requirements. The turret slide has a travel of 7 in. for the No. 3, 9 in. for the No. 5 and 11 in. for the No. 7 machines.

The frictions in the geared friction-head machines are of the cone type and are operated by a hand lever through a long movable sleeve in connection with four fingers mounted on the spindle. The friction is said to

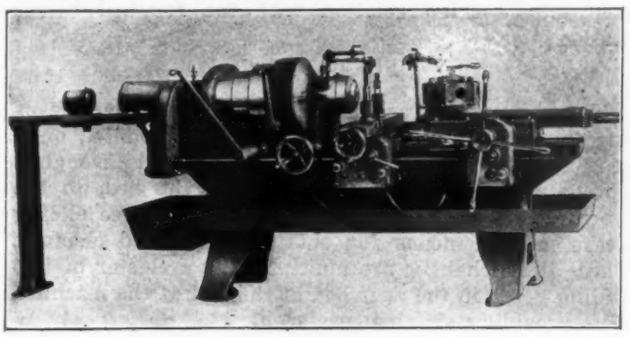


FIG. 2. FOSTER NO. 7 SCREW MACHINE WITH GEARED FRICTION HEAD

be very sensitive in operation and extremely powerful. The front- and rear-spindle bearings are made of bronze and are liberally dimensioned. The spindle is made of a high-carbon-steel forging. The head is cast integral with the bed which is of the double-girder type and is heavily ribbed internally.

Automatic Chuck and Bar Feed

The automatic chuck is of the spring collet type and the hood and spindle nose has been designed to present as short an overhang as possible. The collet-operating mechanism differs materially from the design which has heretofore been used. The automatic chuck fingers are equipped with rollers to eliminate friction at this point.

For the bar-feed operating mechanism on the No. 0, No. 1 and No. 3 machines, the single supporting rod is used, but for the No. 5 and No. 7 machines the stock-support slides on two parallel bars. The continued motion of the automatic chuck lever, as it opens the collet, feeds the bar forward. This is accomplished through a system of links and levers in such a manner that the automatic chuck and the bar feed are operated intermittently.

Turret Slide and Saddle

The No. 0 and No. 1 machines are equipped with a round turret, while the No. 3, No. 5 and No. 7 machines have hexagon turrets.

The verical lock bolt is mounted underneath the front side of the turret virtually directly beneath the working tool.

The end of the lock bolt lever, which intermittently engages the tumbler for withdrawing the lock bolt, preliminary to the indexing of the turret, is equipped with a roller for sensitiveness and reduction of wear.

The rearward travel of the slide indexes the turret by means of indexing pins in the bottom of the turret and a pawl pivoted in the saddle.

The Nos. 3, 5 and 7 machines are equipped with a system of revolving independent stops geared to the turret and index with it. The stop screw abuts a movable stop in the saddle and stands in working relation with the mechanism for disengaging the automatic feed in the saddle apron.

The system of independent stops for the No. 0 and No. 1 machines differs considerably from the one just described for the larger machines. Instead of having the stops revolve with the turret, the stops are mounted in the end of the turret slide. A revolving stop working in the slot between the two lugs on the rear end of the saddle indexes with the turret and brings the proper stop into working relation with the forward turret station

Power Feeds

The power-feed rack is secured to the underside of the turret slide and engages a pinion, mounted on a long through shaft. Motion is transmitted through a power-feed rod on the front side of the bed, to the worm and worm gear in the apron and three sliding gears provide means for obtaining the feed changes. These three changes are multiplied by a cluster of two sliding gears in the gear box at the end of the machine, thus providing six changes in all.

The apron is filled with oil up to a certain level and the lower gears including the worm gear run in a bath of oil.

The cross-feed apron is similar in design to the saddle apron with the addition of sliding gears for reversing the feed movement. The feed friction is operated by a rapid acting cam manipulated by a hand lever. The power-feed apron, together with the carriage and cutoff slide, constitutes a separate unit which is interchangeable with the hand screw cutoff, shown in the front view of the machine and also with the lever-operated cutoff, either of which can be furnished at the option of the customer.

Immediately inside of the handwheel for the hand longitudinal feed is mounted a large graduated dial equipped with observation stops. This facilitates adjusting the cutoff carriage longitudinally. A similar graduated dial with observation stops is also mounted on the cross-feed screw.

Control Systems

Attention is called to the centralized control and the ease with which the various control levers and knobs can be reached by the operator when standing in his natural position in front of the machine. The principal feed changes are located in the aprons. The lever operating the automatic chuck and also feeding the bar is within easy reach of the operator.

For applying the proper amount of coolant to the worm and the cutting tools, the larger machines are supplied with a double system of piping, one working in conjunction with the turret slide and the other with the cutoff. On the smaller machines where a smaller amount of coolant is required, a single system of piping is used.

What Is a High-Grade Machine?

By Oberlin Smith
President, Ferracute Machine Co., Bridgeton, N. J.

The editorial under the above title, on page 285 of the *American Machinist*, is so complete and comprehensive that it is difficult to suggest much in the way of additions and improvements. The analysis of the value of an automobile is a good one, but the selling value of a car depends somewhat upon the reputation of the makers, and is thus to a considerable extent dependent upon fashion—just as is a lady's gown or bonnet. This will affect the selling price somewhat, in addition to a proper combination of your factors—design, material and accurate workmanship.

The Importance of Lightness

In the case of automobiles, lightness of weight without deficient strength is an important factor to a certain extent; but we must remember that too light a machine is more jumpy upon humpy roads than a heavy one, and that this factor should not be considered too far. In the case of flying machines, however, in spite of occasional "bumps" in the air, lightness is a prime factor and must be considered as most important, after proper design and due strength are attained.

In the case of machine tools, all of these same elements apply except fashion, which is not so important, and lightness, which must be reversed; in general, the heavier the machine tool is for a given capacity, the better it is. You doubtless have thought of the old "anvil-versus-fiddle" principle which I so earnestly advocated in your columns some years ago and which has become still more important now, with our high-speed cutting tools. The stationary parts of a machine tool may be as massive as possible, even if of entirely solid metal, the only limit being too much cost. The moving parts, of course must be graduated in weight according to the extent and frequency of the feed movements, especially where these are made by hand rather than automatically.

We have here between the flying machine and the machine tool the greatest possible variation in regard to the element of weight. Countless other machines for various purposes fall in between these two limits, and are of a higher or lower grade according to efficiency and durability by reason of good material, accurate standardization of parts and careful workmanship.

By S. H. Bullard
The Bullard Machine Tool Company

That machine only is "high grade" which embodies in its design and construction those principles, materials, factors of operation, elements of accuracy, and quality of workmanship and finish which, by actual test, have been indicated as the best and most practicable, in all respects, in the arts or industries of which it is a part, or in connection with which that machine is to be utilized.

In the machine-tool field the advanced and accepted practices serving as an index are: The use of alloy steel for gears and shafts, heat-treated as required for service rendered; automatic and continuous lubrication of working parts; single-pulley, constant-speed drive with mechanical speed change; interlocking and centralized control; rapid power-movement of heavy parts; convenient and accurate measurement devices; safety devices for protection of mechanism, and elimination of "points of hazard" for the operator.

EDITORIALS

A Sore Spot That Needs Attention

WHEN is a boil most annoying? Before it bursts or afterward? There is probably little room for argument on this point. After the trouble has come to a head, the rest is usually just a matter of time. But before the climax is reached there is always some doubt as to the extent to which the disaffection will spread and, consequently, some apprehension as well as actual discomfort.

Our industrial life just now is that of a veritable Job. One strike boil after another forms, spreads, comes to a head and bursts. The extent of the spread in each case depends largely upon the local treatment of the malady.

The further the infliction is allowed to penetrate before corrective measures are taken, the greater the upheaval at the crisis and the more the attendant distress.

The traction strikes, the Boston police strike, the steel strike, the coal strike and many others have followed the usual course, and some of them have caused more than the usual amount of suffering to those not at all concerned with the point at issue. These strikes have all been caused by dissatisfaction among the class of the population which we call wage-earners and have met with the general condemnation of those of us who are paid by the week, month or year rather than by the hour.

As a matter of fact the accountants, engineers, clerks, stenographers, etc., have rather more to strike about than the ones who work with their hands. Endless statistics are available to show the rise in the cost of living and the attendant increases in wages. Usually, the two have very nearly kept pace and in some cases the wage curve is ahead. But have salaries increased with the cost of living? With very few exceptions they are just what they were five years ago and we often wonder how some of the poorer-paid salaried men are managing to get along.

The situation is handled without gloves in a recent number of *Automotive Industries* by a member of the staff of that publication. He says in regard to the salaried workers: "Their present position is the greatest justification for labor unions which will be found in the industrial fabric. The only reason why the salaried workers have not received the attention which has been given the skilled and unskilled laborers is because they have not organized and used their power of organization to force the situation. The continued neglect of their position, however, and their value to industry not only as workers, but as part of the conservative thought of the middle classes, is creating a sympathy with the suggested advantages of, and stimulating a growth in radical and socialistic ideas among this portion of the population that is perhaps more to be deprecated and more significant in its consequences than the growth of similar opinions among labor ranks."

We sincerely hope that the extent of the sympathy with radical ideas, which is mentioned in this article, has been exaggerated and we believe that such is the case. We incline to the belief that men of this class have rather too much intelligence to accept socialism of the radical type as the panacea for their ills, but this does not mean that action of some sort will not result from a continuation of the present arrangement.

Most of the men, and women, on salaries are gradually coming to a realization of the fact that their loyalty to their employers has resulted in too many cases in nothing but loss to themselves.

When a loyal and hard-working engineer who has put in years of service at an inadequate salary, has finally been promised a raise which is not only deserved but absolutely necessary if he is to keep his home together, and then has that raise held up until the company finds out how much it is going to be compelled to pay striking laborers to get them back, he is quite apt to decide that there is something wrong.

He sees the so-called skilled laborers under his direction getting more money than he does, solely because they have organized to secure the power to obtain it. Is he not good material for clever propaganda looking to the overthrow of the existing order?

We read in the daily press that our inexcusably lax immigration laws and the inadequate corps of inspectors trying to enforce them, are allowing I. W. W.'s to slip into the country at the rate of a hundred a day. By all means let us do everything possible to get rid of the ones we have and keep out others but, at the same time, why not look over our industrial anatomy and see if there isn't something we can do to prevent this particular boil from coming to a head. If we don't, the chances are that it may sometime develop into a cancer that will destroy the whole body.

According to the handle of our most advertised tooth brush, "A Clean Tooth Never Decays." This is true of other things besides teeth. When we have cleaned up our system of organization so that the staff as well as the rank and file is satisfied with things, the radical will be as impotent as the decay germ trying to bite polished enamel.

It will be as well not to delay the renovation, as germs multiply fast when once the defending wall has been broken down. Better to save the sound tooth than to let it decay and substitute a false one for it.

The Upset Balance

THE International Trade Conference just held at Atlantic City brought out very clearly the difficulties in the path of the restoration of the trade balance between Europe and America. The able delegates sent by England, France, Belgium and Italy had every figure necessary to show clearly the present state of reconstruction and the estimated needs for the immediate future, and evidenced an independent, optimistic spirit which augurs well for the future of Europe. The one outstanding problem, however, was shown to be that of financing the trade in the American goods which are badly needed abroad.

At the present rate of exchange the Belgian must pay us a seventy-two per cent. premium on everything he buys. In addition to this, the cost of American machinery is relatively high because of the wages demanded by labor to meet the high cost of living. Transportation charges are excessive by reason of the many harbor strikes, trainmen's strikes and the unreasonable demands of the unions in general for more pay and less work.

At present we have an export trade balance of approximately four billion dollars annually; in other words, we are selling more goods than we buy. Before the war American tourists returned a fair share of our surplus gold to Europe and the returning foreign laborers, many of them Italians, also took back enough sockfuls of cash to make an appreciable reduction in the trade balance and help to bring it within reasonable limits. And of course we were importing a large amount of all sorts of products, the manufacture of which was abruptly cut off at the outbreak of the war.

During the war there were no tourists except the Expeditionary Forces and many of the laborers were called home to the colors. At the same time there was an increased demand for food and munitions of all sorts and the result was the building up of an export balance which seemed to indicate that eventually all the ready cash of the world would be in America. If such a condition had actually been reached the rest of the world would have been reduced practically to the old barter system of trading and a universal catastrophe would have occurred.

You can't expect to keep on selling goods to a man if he can't make money enough to pay for them; nor can you expect him to get his business on a paying basis at once after such a setback as the great war has been to Belgium, France and Italy. In such a case the wise business man lets up on his usual credit restrictions and extends a helping hand until his customer gets on his feet. This isn't charity nor sentiment; it's the best kind of hard business sense. The sentiment enters in when it comes to securing an order from the debtor against keen competition. Is it likely that he will forget the helping hand which saved his business life? There isn't a doubt that the man or firm or nation that extended extra credit will get the order if there is a possible chance.

This homely example points the path we must follow. A long-term credit must be extended and the business men of all the countries involved declare that it must be private credit and not a government loan. The representative of the Treasury Department at the Trade Conference indorsed the stand with the statement that the Government had extended about all the foreign credits possible under the present system. Just what form the drive for subscriptions to this huge credit fund which must be raised will take, we have no idea, but it is the duty of every real American to back it to the limit, both for the good of his own pocket and for the good of his country's business.

Increase Production by Reducing Waste

THERE may be said to be two ways of increasing production—one by speeding up the men and the machinery, the other by reducing the proportion of defective or waste product. The latter has many advantages and receives far too little attention.

Perfection is out of the question and an inspection room with no rejections would be as great a danger signal as one where the rejections are too high. But there are few shops where it will not pay to study the defects of parts which do not pass inspection. A saving of this kind is a step toward real efficiency, assuming of course that the net cost of the work of saving does not exceed that of the previous wastage.

In many cases it will be found that the design, or an unnecessarily severe specification or inspection may be responsible for a large percentage of the waste. In others, the trouble lies in an injudicious attempt to speed production on machines or to urge undue haste in hand work without, perhaps, providing suitable facilities.

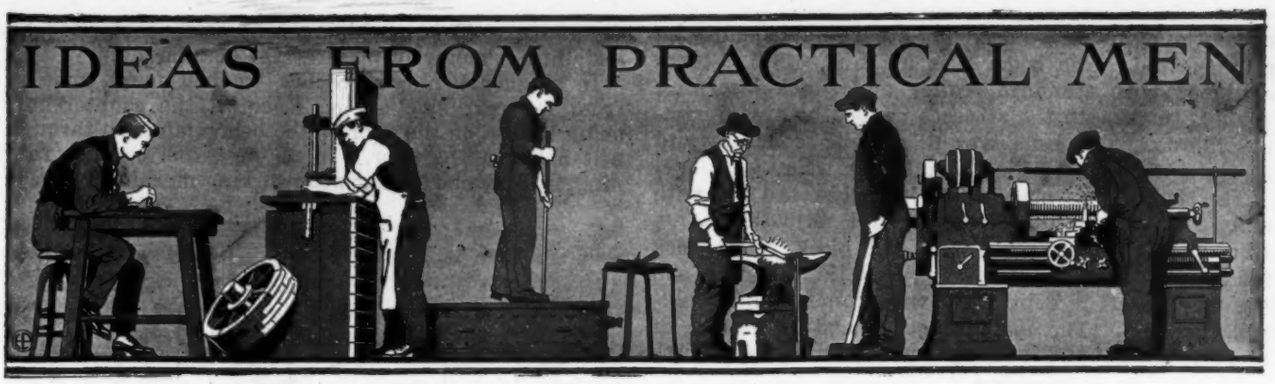
A careful study of the percentage of rejections, of the defects which prevent their use and the causes of these defects, makes a good starting point. These will determine how much can probably be saved in this direction. That such a study is well worth while can hardly be questioned. For it is the net saving that counts, and the smaller percentage of our effort and material we waste, the greater are our real economies, and the less the cost of our product.

The first step in many cases is to consider the design from the standpoints of use and of manufacture. Here both the users and the men in the shop who actually make the part, or the machine, should be consulted. The need of more or less severe specifications can also be determined at the same time. Then the machining equipment and methods can well be studied while the personnel—the temper and temperament of the foreman—should not be overlooked. The effect of poor lighting or other shop conditions is often reflected in the amount of material rejected at final inspection and uneven temperature in different parts of the shop have also been known to affect the size of pieces when they reached the assembling stage.

Training for Foremen

THE necessity of war production led to the extensive adoption of the plan of training employees of various kinds and, as is generally known, interesting and remarkable results were secured. One of the striking and encouraging phases of this was the training of foremen and sub-foremen to the importance of their duties. In one large shop, at least, the work of its war-time training department made a deep impression on the management, which is arranging for the special training of every sub-foreman in the shop. It will be their duty to take the men and women as they come from the training department and, by becoming familiar with training methods, to upgrade these employees as far and as fast as possible.

The effect of this on the work has been so noticeable that the main foremen of the various departments have themselves requested that they be given a very complete insight into the whole training method, so as to better appreciate the work of the employees and of the sub-foremen and also to be in a position to assist in the upgrading in every way possible. Owing to the familiarity of the foremen with the different phases of the work in the shop, it is believed that a few talks by the chief instructor will give them sufficient insight into the work to enable them to understand its trend and methods, and, in this way, be of far more value in securing increased output throughout the whole plant.

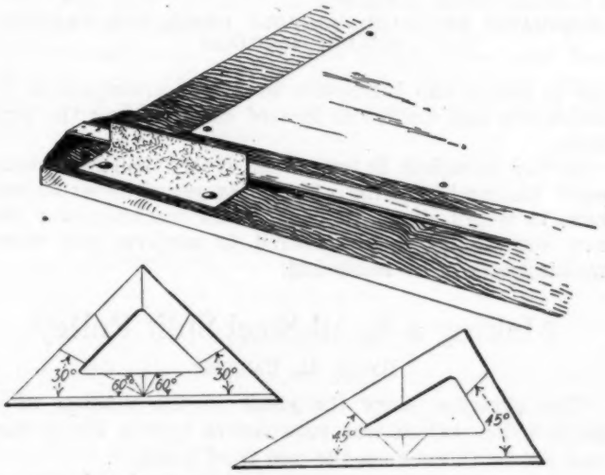


Drafting-Room Kinks

By Henry H. Moore

To stop vibration of the drawing board, place pieces of ordinary erasers under the legs of the table.

To produce a title panel on a tracing cloth that will give on the blueprint every appearance of a press-printed panel, ink in the wet impression made



USEFUL DRAFTING-ROOM KINKS

by an ordinary rubber-stamp title panel on the tracing cloth.

Lines scratched on triangles, perpendicular, 60, 45 and 30 deg., all to one point on a line parallel to the longest edge, will aid considerably when laying out work.

The most convenient article on my drawing board is an ordinary strip of blotter, 1 x 5 in. long, bent in half and held down to the lower left-hand corner of the board by two thumbtacks, as shown in illustration. It serves three good purposes: to remove ink from instruments; to prevent T-square from falling to floor and as a stop against which drawings, pencils and pens may temporarily be placed.

A Novel Adjustable Reamer

By W. H. Frick

The illustrations show an adjustable reamer designed by the writer which he believes to be novel. Fig. 1 shows the reamer in section while Fig. 2 shows it almost wholly disassembled. Like parts in both illustrations are denoted by the same reference letters.

The blades *A* are made of round steel, fluted to form the cutting edges, and have gear teeth cut on parts of their inner ends at *B*. The teeth on the ring gear *C* mesh with the teeth on the blades so that a partial revolution of the ring gear will partly rotate the blades in their circular seats. By this means, the size of the

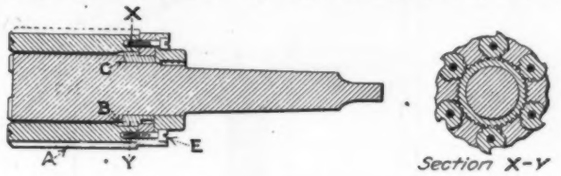


FIG. 1. THE REAMER IN SECTION

reamer can be adjusted, maintaining its accuracy without grinding.

No claim is made for a wide range of adjustment, the purpose being to provide a reamer that will ream a hole from 0.005 in. below to 0.005 in. over size, which should cover all ordinary requirements.

It will be noted that grinding the cutters does not

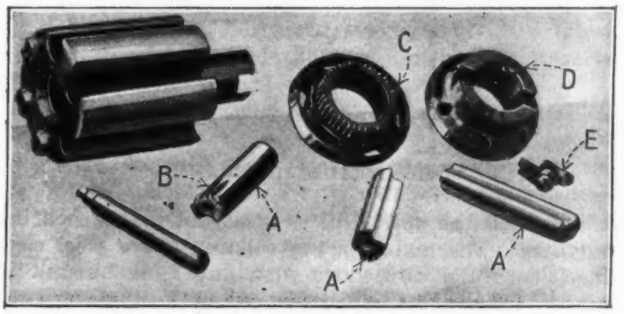


FIG. 2. THE REAMER DISASSEMBLED

reduce the diameter of the reamer, as when they are set with their cutting edges radial the maximum size hole will be reamed.

After adjustment, the cutters are locked by clamping the ring gear between the reamer body and the back plate *D* by means of the screws *E*.

A Revolving Jib Crane

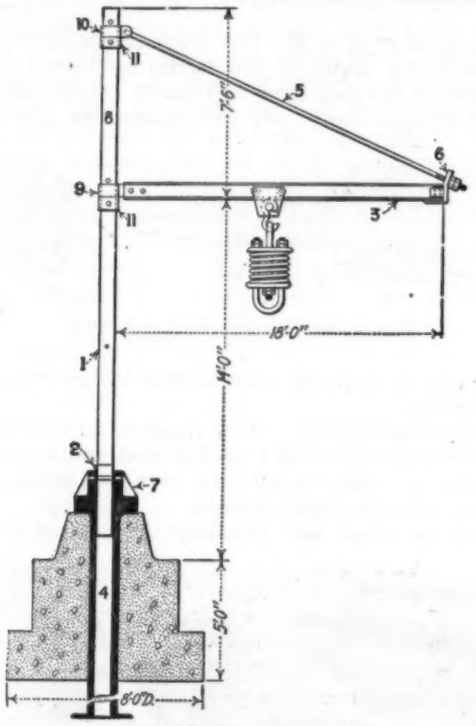
By H. A. Pearson

The illustration shows the arrangement of a home-made jib crane for use in a forge shop. The crane has a full 360-deg. swing and might be very useful in any shop. Many of the details are as they are because they happened to be available from our scrap pile. Some one else's scrap pile would probably yield pieces entirely different but just as usable.

The mast of the crane *1* is a 20-ft. length of extra heavy 8-in. pipe. The collar *2* was used simply be-

cause the cylinder we used for a base happened to be counterbored. The boom *3* is an 8-in., 18-lb. I-beam equipped with standard trolley and shock-absorbing springs to take up the stresses caused by steam-hammer blows. The base was filled with concrete and capped with a steel disk *4* to take the wear.

The tie rod *5* is made of 1½-in., cold-rolled rod with a long thread on the lower end for adjustment. It runs through the forged-steel end block *6*. A lock pin *7* prevents turning of the mast in the base and the mast itself is reinforced with concrete and cold-rolled rods *8*. The main hinges *9* and *10* consist of steel forgings and are equipped with grease cups



HOMEMADE JIB CRANE

which feed the spiral oil grooves cut in the bearing surfaces. The main-bearing collars *11* are steel castings, carefully turned to size and then shrunk in place. They are further secured by ¾-in. pins. Lock pins above the hinges prevent them from riding up.

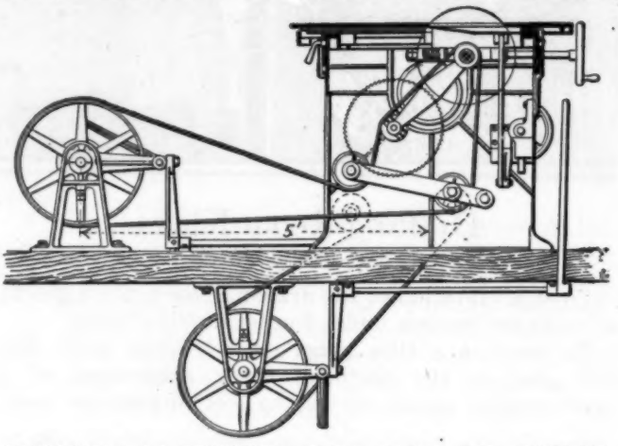
Safety First on a Circular Saw

BY ARTHUR SEWARD

The caution contained in M. E. Duggan's article under the above caption, on page 385 of the *American Machinist*, struck a responsive chord in me as I have had the unpleasant experience of being nicked through just such carelessness as mentioned by Mr. Duggan, namely, reaching over the revolving saw.

While inconsistencies occur in the best-regulated channels it seems to me that the illustration of the article in question has leaped beyond all hard-and-fast rules of machine design and installation. I would like to have Mr. Duggan tell me how he expects to drive the saw with the belt in the position shown. The machine is what is known to woodworkers as a double-arbor universal saw bench, two saws being mounted on a revolving yoke and belted as shown in the appended illustration. This arrangement brings the belt-shifter unit to the front of the machine within easy reach of the sawyer. This machine can be easily motorized by installing a motor in place of the countershaft.

In single-arbor saw benches the belt must come in from the rear side of the machine, the countershaft being located on the floor or the belt coming up through belt holes in the floor. In all my experience in running, making and selling woodworking machinery I have



SCHEMATIC OF STANDARD BELT DRIVE FOR VARIETY SAWING MACHINES

yet to see or can I conceive of a belt arrangement in which the belt shifter is located directly over the saw table.

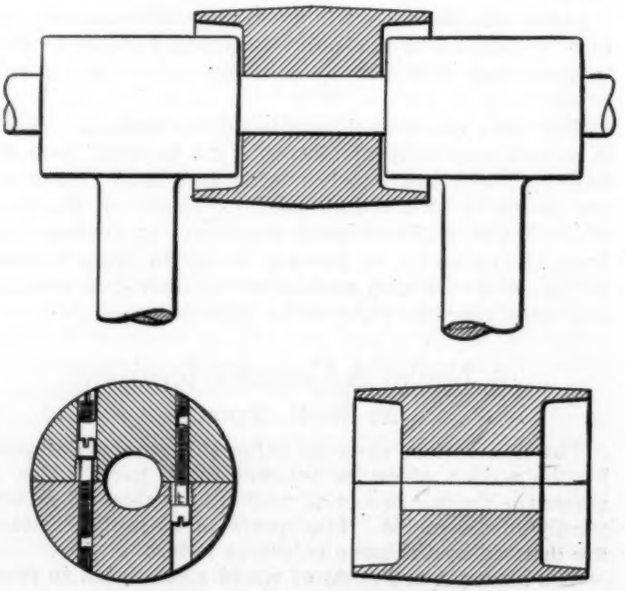
So far as safety is concerned, if Mr. Duggan would equip his machine with a first-class guard he would not have to worry about accidents when reaching over the saw nor would he be required to perform any wire-walking stunts of balancing.

Making a Small Steel Split Pulley

BY H. H. PARKER

The sketches show the steps in the making of a small pulley which was required to have a 2½-in. face and yet to fit between the two fixed boxes.

A suitable length of steel shafting was cut off, and a $\frac{13}{16}$-in hole drilled lengthwise through it. It was then sawed in half and the two flat surfaces dressed. Two



MAKING A SMALL PULLEY QUICKLY

$\frac{7}{32}$-in. holes were drilled in each half, $\frac{11}{16}$ in. from the central hole, by first drilling one piece, then clamping both together and using the first as a jig to drill the second. Alternate sides were then counterbored to $\frac{21}{64}$ in. and tapped $\frac{3}{8}$-24 for about $\frac{1}{4}$ in. from the flat side. Two $\frac{3}{8}$-in. rods were then threaded for a short distance, screwed tightly into the tapped holes, sawed off and filed flush with the surface. (If a left-hand tap and die had been available it would have been better).

The two pieces were then clamped together again and the two plugs drilled out to $\frac{7}{32}$ in. then taken apart and counterbored to $\frac{1}{4}$ in. while the remaining $\frac{7}{32}$-in. holes were tapped $\frac{1}{4}$-28. As will be seen, the plugs formed seats for two $\frac{1}{4}$-in. fillister-head screws which held the halves together; hence they should be a tight fit.

Next the halves were screwed together, chucked, and one end counterbored. Reversing the piece in the chuck, the other end was counterbored and the hole bored and reamed to $\frac{5}{8}$ in. The pulley should be a good fit on the shaft to prevent the halves skewing and to clamp the shaft tightly.

It then only remained to clamp the pulley around a mandrel and machine the outside. Two plugs were screwed permanently into the tapped holes and filed off flush with the outside surface; plugs with screw slots could also be put in over the clamping screws and filed even with the pulley surface.

If the pulley fits the shaft correctly it should not be necessary to use a setscrew.

Cross-Checking System for the Tool Crib

By Robert Hofstetter

I would like to know if the following idea of a tool-check system has ever been published or advocated heretofore. If not, I would like to see it published in *American Machinist* for the benefit of your readers.

The basic idea of the system is that it enables the tool-crib man to know how many and what tools any man has checked out.

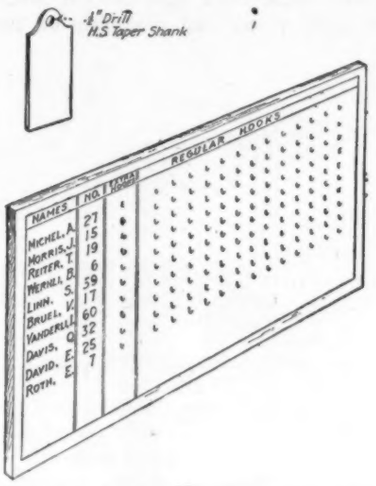
It sometimes happens that a man, after turning in all the tools he remembers to have used, is shy one or more checks, but neither he nor the crib man is sure what tools they represent.

Should the man wish to leave, it means going all over the crib to find the missing check, and if it is not found, the chances are that the man will get fined 50 cents or so for the loss of a check.

In order to overcome the drawbacks of the present system, I would suggest making a tool check about $\frac{1}{2}$ in. wide by $1\frac{1}{2}$ in. long for each tool, giving a brief but clear description of the tool, as for instance: "$\frac{1}{2}$-in., high-speed, taper-shank drill," "$\frac{5}{8}$-in. hand reamer," or "drill jig F-51-4." If necessary, both sides of the check may be used for the description. With modern etching methods (acid or electric), this would be a fairly simple procedure. Place the proper number of checks near each tool. If you have ten 1-in. drills, it would require ten tool checks, each marked "1-in. taper-shank drill."

Provide a board, as shown in the illustration, in the tool crib, having the men's names and numbers shown vertically on the left. Opposite each name is provided a certain number of hooks (one more than it is customary for each man to have checks). Supply each man with the desired number of checks, different in shape and color from the tool checks.

A man calling for a tool, say a $\frac{1}{2}$-in. drill, will hand in his check which will be placed on the extra hook on the board, opposite his name and number. As the $\frac{1}{2}$-



THE CHECK BOARD AND A TOOL CHECK

in. drill is removed from the rack, a tool check reading $\frac{1}{2}$-in. drill is also removed and placed on the board opposite the man's name.

It is obvious that the tool-crib man can tell at a glance how many tools each man has out, for all he needs to do is to count the man's checks hanging on the board opposite the man's name and number.

If it is desired to know what tools are checked out by any man, it is fairly easy to read the description on each tool check and thus obtain this information also.

Sometimes it may happen that the supply of tools is rather limited and it is necessary to find out quickly who has a certain tool. Under these conditions, the man's check instead of being placed on the extra hook on the board will be placed (the same as now) on the tool rack, preferably in place of the tool check, the latter, of course, finding its right place on the board.

Even under these conditions, the tool-crib keeper can tell from a glance at the board, how many and what tools any man has (the tool checks alone giving this information). Again, from the checks at the rack, he can tell without difficulty, who has a certain tool.

Under these improved conditions, there is no need for a long search of checks in case a man quits. He can be told what tools he failed to return and a report can be sent to the employment office or paymaster, stating the correct condition, and proper adjustment can thus be made.

A Homemade Oil Filter

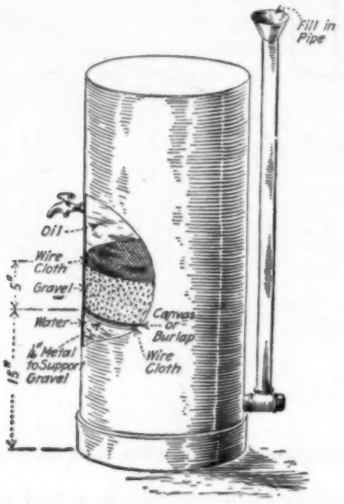
By Wm. H. Steele

The sketch will show how an oil filter can be made at very little expense out of old material that may be found around any plant. I made one out of an old water heater, about 30 in. long and 12 in. in diameter.

Make the lower end so it can be removed for cleaning out sediment, and, about 15 in. above the bottom, solder or otherwise fasten in place a partition of $\frac{1}{16}$-in.

sheet metal perforated with ½-in. holes. On top of the partition, place a screen of fine-mesh wire cloth, and on top of that a couple of layers of canvas or burlap. Fill in on this about 4 or 5 in. of fine gravel about the size of a pin head; then place on top of the gravel another screen of wire cloth.

Tap into the tank near the bottom with whatever size pipe is handy; run out a couple of inches to an



IMPROVISED OIL FILTER

ell or tee and turn upward to a height about 1 ft. above the top of the tank. Fill filter with water to about the bottom of the gravel, and pour the oil to be filtered into the pipe. The oil will bubble up through the water, gravel and burlap, and be very thoroughly cleaned.

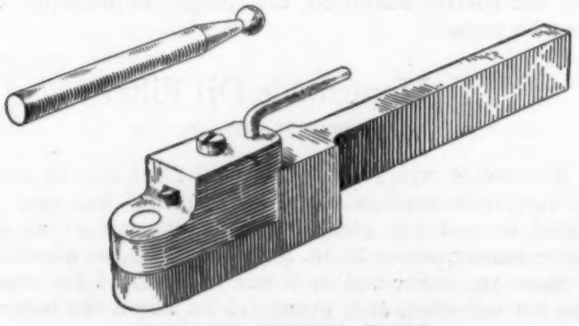
I have filtered machine oil in my filter that was as black as tar and very stiff with dirt, restoring it to its original color and usefulness.

Turning a Ball on the End of a Rod

By C. W. Buckey

Having seen, at various times, articles published in the columns of *American Machinist* descriptive of devices for accurate ball turning, I am sending you a sketch of one such tool that I made for my own work. It is more simple in construction than most of those heretofore shown, and performs its work in a satisfactory manner.

The shank is forged to fit the toolpost of the lathe and the enlarged end of the holder milled out to take the moveable piece, which turns freely on the central stud. It can be made for any diameter of ball within



TOOL FOR TURNING BALLS

the capacity of the lathe, but its range of adjustability is necessarily small.

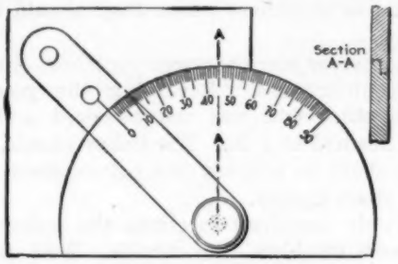
Care should be taken in using the tool to get the flat surface level and to have the center of the stud coincide with the center of the finished work.

Draftsman's Protractor

By Gustave F. Bahr

The protractor shown herewith is one I designed for my own use and I think it has some advantages over the ordinary tool of this kind. The sketch shows its construction quite clearly.

One of its advantages is that when set to any angle,



DRAFTSMAN'S PROTRACTOR

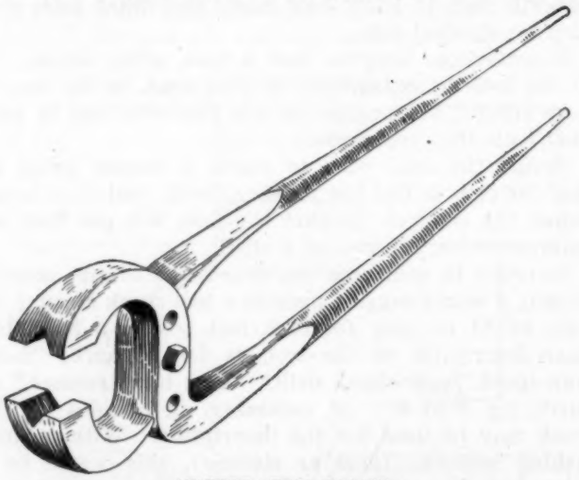
the complementary angle is available without turning over the instrument or reaching for a triangle.

It may be made of celluloid or metal as desired. If of metal, the arm must have a window or opening through which to observe the graduations. The joint is made as shown in the section, and the arm is fastened to the body by a stud and thumb nut.

A Pair of Adjustable Tongs

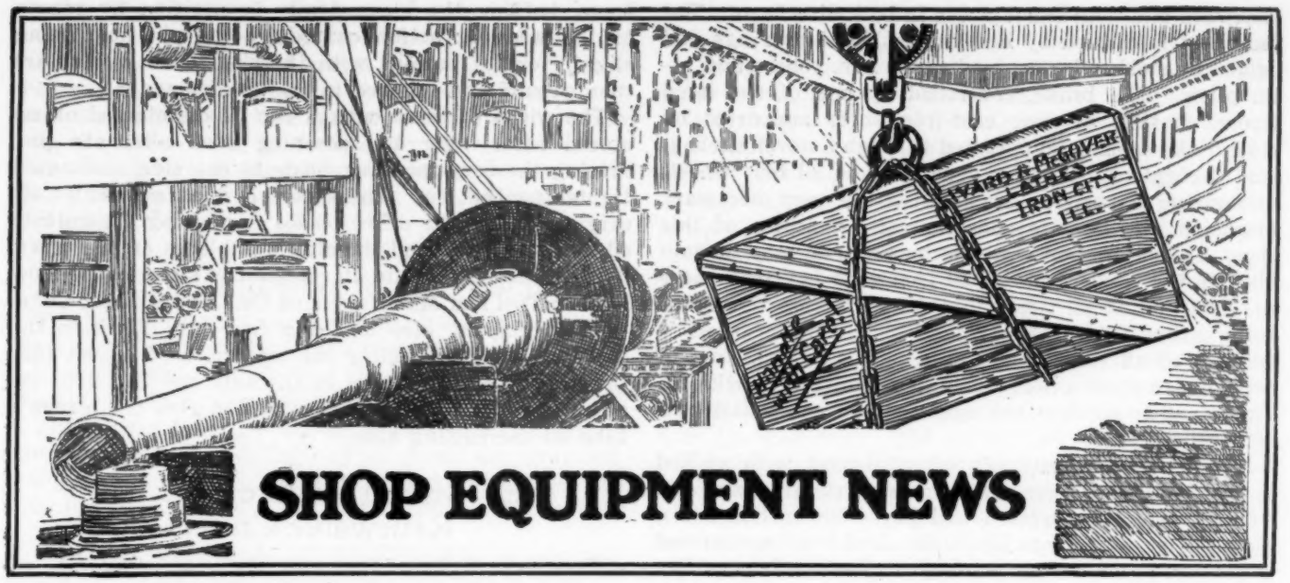
By S. B. Royal

A useful pair of tongs for the forge may be made as shown herewith. Each half has three holes of slightly different spacing, in any of which the bolt may be used. In this way we can have a pair of tongs that



ADJUSTABLE TONGS

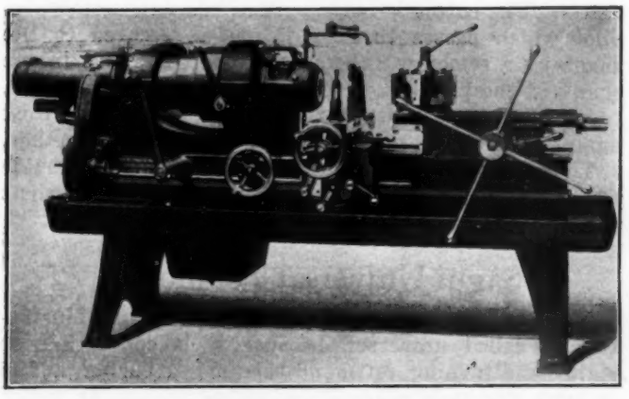
will hold tightly any size within its capacity, with the jaws practically parallel. This keeps the work from rocking, for if the jaws are not parallel the work will be clamped at only one point. The jaws may be made as desired for round or flat stock or in the form of a combination jaw, as shown, which will accommodate either.



Warner & Swasey No. 6 Turret Lathe

The Warner & Swasey Co., Cleveland, Ohio, has added to its line the No. 6 turret lathe shown in the accompanying illustration. This machine is equipped with double-friction back gears and can be furnished with or without automatic chuck, bar feed, or power feed to turret. Either the standard or the heavy-duty carriage can be furnished.

The heavy-duty carriage has six power crossfeeds, obtainable from the apon. The longitudinal feed is by hand. The gears in the apron are made of steel and



WARNER & SWASEY NO. 6 TURRET LATHE WITH HEAVY-DUTY CARRIAGE

Specfications: Swing: over bed, 20⅜ in.; over carriage guides, 18¾ in.; over cross-slide, 9¼ in. Capacity of automatic chuck: round, 2¼ in.; square, 1 9-16 in.; hexagon, 1 15-16 in. Spindle: hole, 2 21-32 in.; thread on nose, 6¼ in. in diameter; pitch, five per inch. Cone: three steps; width of belt, 3½ in. Turret: tool holes, 1¾ in.; center of holes to top of slide, 3⅝ in.; width across flats, 10½ in.; power feeds, four. Heavy-duty carriage: cross-travel, 10 in.; longitudinal travel, 14 in.; power feeds, six. Standard carriage: cross-travel, 9 in.; longitudinal travel, 10 in. Countershaft (double-fricton): pulleys, 14 in. in diameter; belt, 4 in.; speeds for brass, 320 r.p.m.; speeds for steel, 160 r.p.m. Horsepower required, three Floor space, 32 x 104 in. Weight, 3600 lb

run in oil. The cross-slide is fitted with a dial graduated to 0.002 in. and adjustable stops are provided for both directions. The standard carriage is equipped with hand feeds only.

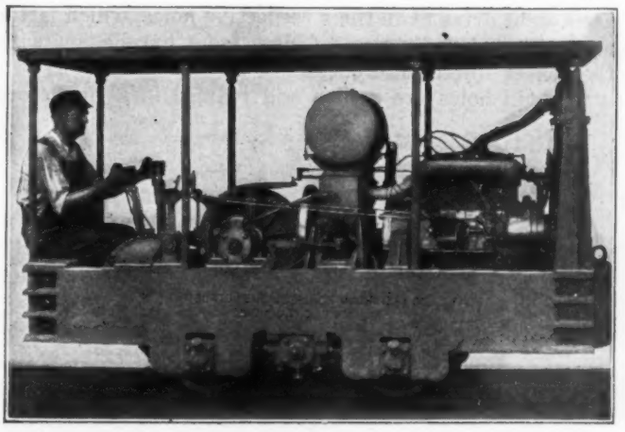
The head and bed are cast in one piece, making a rigid unit. The hexagon turret is arranged for holding six tools either with or without shanks. The tool holes are counterbored for centering plate tools and are fitted with draw bolts. Independent adjustable stops operate automatically for each position of the turret.

The turret saddle has a supplementary taper base for adjusting the height of tool holes to that of the center line. Taper gibs the whole length and on both sides of the saddle provide means for side adjustment. Power feed having four changes can be furnished for the turret slide if so ordered. An oil pump, operating where the machine is run in either direction, is part of the regular equipment.

The Burton Industrial Locomotive

The industrial locomotive shown is designed to operate on either gasoline or kerosene and is built in sizes ranging from 3½ tons to 25 tons. It is the product of the Burton Engineering and Machinery Co., Cincinnati, Ohio.

Simplicity of construction and operation are the essential features of this locomotive; the power is transmitted direct through a spur friction acting on the face of the flywheel. All clutches, differential gears, and other complications are eliminated, and the control-



THE BURTON INDUSTRIAL LOCOMOTIVE

ling levers are located convenient to the operator. The spur friction wheel is 22 in. in diameter and slidably mounted on a large shaft supported by Hyatt heavy-duty bearings. This friction wheel may be shifted across the face of the flywheel by means of a hand lever, thus obtaining the full range of speed forward or

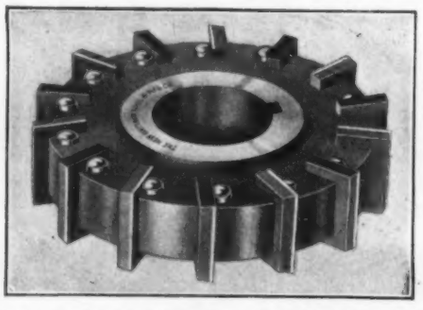
backward and with equal power in both directions. The jackshaft is carried by heavy-duty Hyatt bearings and driven by steel roller chains having ⅞-in. rollers and 1½-in. pitch. The brake, controlled by one of the hand levers, consists of four cast-iron shoes supported on steel brake beams and operated through a novel mechanism of toggle construction equalizing on all four wheels and giving a positive brake action—a very necessary provision for the safe operation of a machine of this type. In conjunction with the brake, sand may be supplied to the track from a cast-iron sand box that keeps the sand hot at all times; the exhaust from the motor being utilized for this purpose. The flow of sand is positive at all times which is a necessary principal in assisting to start a heavy load under adverse track conditions. The sanders are operated by foot pedals conveniently located.

The driving wheels are of semi-steel with chilled flanges and rims, ground to a true running surface. These wheels are pressed and keyed on special axles, mounted on extra large Hyatt standard bearings carried in journal boxes having ample provision for lubrication. Coiled springs of the proper size insure smooth running and protect the machine from undue shocks. Steel roller chains running on cast-steel cut sprockets are used throughout. The motor is of the latest type Herschell-Spillman four cylinders, cast enblock. The engine equipment includes Bosch high-tension magneto, Zenith automatic carbureter, Pierce mechanically driven governor, and radiator having a cast-iron shell, honeycombed core and spring hangers to absorb all shocks such as a machine of this type is subjected to. There is also a guard in front of the radiator to protect it from damage by material that may project from the loaded cars in actual work. The cab is of wood and metal construction, extending the entire length of the locomotive, and providing ample room for the operator; also permitting free access to all parts of the machinery.

New Britain Inserted-Tooth Cutter

The body of the cutter shown in the illustration is made of mild steel and the blades of high-speed steel. The pins that hold the blades in place are parallel and are a light drive fit in their respective holes, which latter are drilled at an angle of 6 deg. from parallelism with the center line of the cutter.

The pin holes are drilled and reamed in a jig before



NEW BRITAIN INSERTED-TOOTH CUTTER

the body is slotted for the cutters. The pins are then driven in, and the slots cut parallel to the center line of the cutter in such position that each slot cuts partly into its respective pin, leaving the pin with a tapered flat side coinciding with one side wall of the slot.

The blades are then forced in and each pin driven home, holding the blade firmly in position by reason of the wedging action caused by the pin hole being slightly out of parallel with the slot. The cutters are then ground and relieved in the usual manner.

The width of these cutters can be maintained or restored after wear by loosening each alternate pin, driving the corresponding blade to one side, and again tightening the pin. The cutter is then ground to its original width, the offset blades furnishing the cutting edges on one side and the alternate blades on the other.

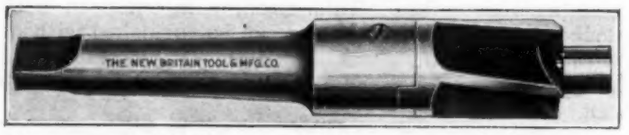
The cutter is made in all commercial sizes by the New Britain Tool and Manufacturing Co., New Britain, Conn.

This company also makes a face-mill in which the same principle of holding the teeth is used except that the pin holes are parallel to the axis and the slots cut at an angle of 6 deg. This serves to give the blades a rake on the cutting side.

New Britain Counterbore with Renewable Cutter

The New Britain Tool and Manufacturing Co., of New Britain, Conn., has placed on the market a counterbore with renewable high-speed steel cutter.

The shank of the tool is made of carbon steel and drives the cutter by means of a keyway across its end,



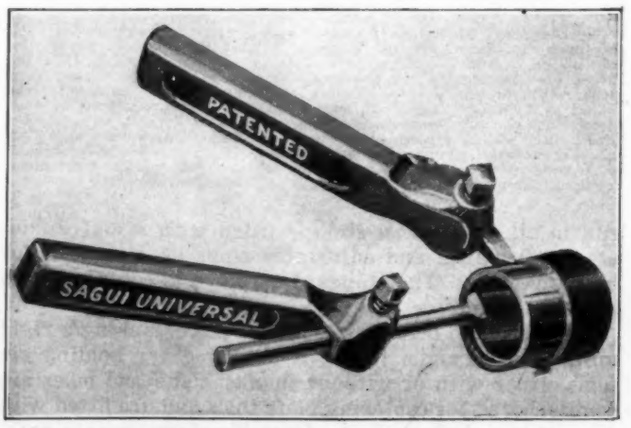
COUNTERBORE WITH HIGH-SPEED STEEL CUTTER

into which fits a substantial key made integral with the cutter. The cutter is held in position by the removable pilot which passes through it and is secured to the shank by a setscrew. A shallow tapered groove in the shank of the pilot takes the point of the setscrew and, because of its taper, tends to draw the cutter back against the shank, holding the parts tightly together.

The cutter is made with unusually long lips to provide for repeated grindings of the cutting edge. Various sizes of pilots are furnished with the tool.

Sagui Universal Toolholder

The toolholder shown in the accompanying illustration is called universal, because it is convertible to right-hand turning, left-hand turning, or boring, and is suitable for tools made from either square or round



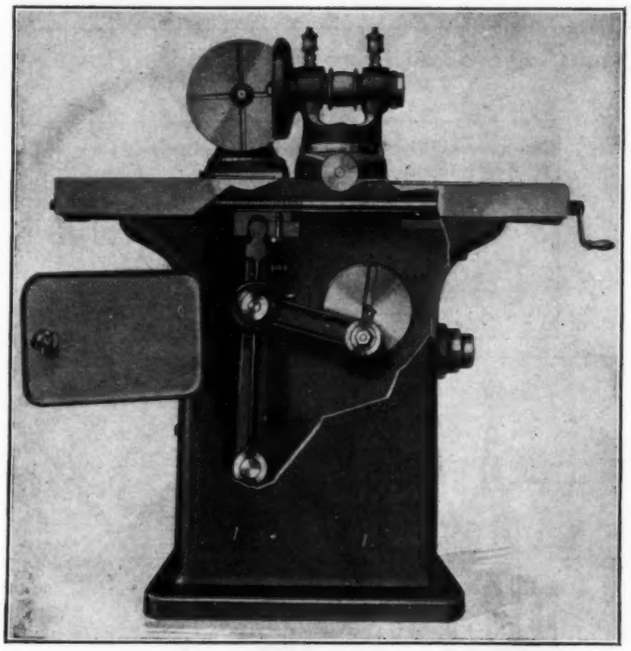
SAGUI UNIVERSAL TOOLHOLDER

stock. The illustration shows two views of the same tool with the setscrew in different positions, a threaded hole being at both sides for that purpose. The hole for the tool bit is broached square besides being reamed and, as a consequence will hold square or round stock equally well, the latter being preferable for boring operations. This toolholder is being manufactured by the Universal Tool and Manufacturing Co., Inc., 680 South 11th St., Newark, N. J.

Cleveland Face-Grinding Machine

The machine shown in the illustration was designed especially for grinding metal-slitting saws, hubs of milling cutters and similar work, by the Cleveland Machine Tool Co., Cleveland, Ohio.

The cabinet base is a one-piece box section, L-shaped for strength and stability. Two doors are provided, one permitting easy access to the working parts of the machine for oiling and adjustment and the other making



CLEVELAND FACE-GRINDING MACHINE

Specifications: Capacity diameter, 12 in.; thickness, 6 to 10 in.; table, 42 x 9¾ in.; stroke, 0 to 6 in.; feed changes, six; drive pulley, 3 x 2 in.; lateral adjustment of saddle, 2 in.; maximum wheel diameter, 8 in.; adjustment of work-head saddle, 6 in.; taper hole in spindle, No. 11 B. & S.; working space required, 57 x 40 in.; net weight of machine, 1500 lb.; domestic shipping weight, 1880 lb.; boxed for export, 1700 lb.; net weight of countershaft, 280 lb.; boxed for export, 380 lb.

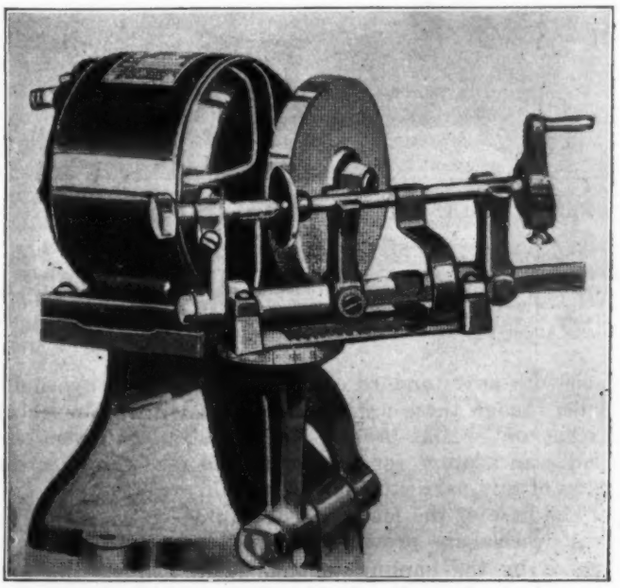
a large interior available as a storage place for tools, grinding wheels and attachments. The table has one V-shaped and one flat way that give ample bearing surface and, owing to the fact that the table is larger than the ways, the latter are always covered and kept free from dust and grit. The table is provided with a crank-handle adjustment for regulating the stroke. It is also so designed that, if necessary, a cutting fluid can be used on the machine though a pump is not furnished as standard equipment. A steady, reciprocating motion of the table is obtained by a crank disk driven through worm gearing.

The stroke is readily adjustable from nothing to 6 in., which means that the machine has a capacity for all sizes of work up to 12 in. in diameter. Six feed changes are possible, by means of a three-step cone pulley on the machine combined with a two-speed countershaft. The grinding-wheel head is fitted to a saddle that is secured to the main part of the column by a dovetail slide, gibbed to provide adjustment for wear. The saddle has a lateral adjustment of 2 in. and is designed to exclude dust from its bearing surface. The adjusting screw for the saddle is provided with a micrometer dial. This head is graduated to 30 deg. and can be turned to any desired angle, thus permitting the use of wheels of various shapes. The grinding-wheel spindle is made extra large, of special steel, hardened and ground and fitted with adjustable bearings of phosphor bronze.

The drive pulley is 3 in. in diameter with a 2 in. face and is mounted midway between the bearings. Large grinding-wheel flanges are provided and also a wheel guard large enough to accommodate grinding wheels 8 in. in diameter. The work head is secured to the wing of the column by a dovetail slide and rests on its own saddle which has a longitudinal adjustment of 6 in. A hand clamping screw is provided to lock the saddle in position and a gib is furnished making the slide adjustable to wear. The machine will accommodate work 6 in. in thickness without overhang of the saddle, and has a capacity for work 10 in. or more in thickness, by allowing a slight overhang of the saddle and using a wheel approximately 5 in. in diameter. The work head is pivoted on the saddle and can be swung to any desired angle. The work spindle is extra large, hardened and ground and fitted with adjustable phosphor-bronze bearings of ample size. The spindle has a No. 11 B. & S. taper hole and a nose threaded to receive a 10-in. faceplate which has T-slots placed at right angles for clamping the work in position. Two drawbolts and two collets are furnished as part of the regular equipment.

Dunham Motor-Driven Valve-Grinding Machine

A bench grinding machine designed primarily for valve facing, but with an extra hub and wheel, permitting the grinding of small tools, etc., has been introduced by D. F. Dunham, 830 West 37th St., Los Angles, Calif. The machine is equipped with a $\frac{1}{12}$-hp., high-



DUNHAM VALVE-GRINDING MACHINE

speed Westinghouse motor of standard construction, mounted upon a neat and rigid base. It may be quickly made ready for use by connection to any lamp socket through the medium of a drop cord and plug which is included in the equipment. A single snap-switch is used to set the motor in motion. The machine is always "set-up" and ready for service, as a ball-and-socket arrangement on the adjusting screw makes it possible to grind valves whose centers have been multilated or which have no center. Simple adjustment features adapt the machine for use with valves of various sizes and shapes. While grinding, the valve is moved back and forth across the face of the wheel and at the same time rotated by the hand crank.

Multi-Angle Portable Radial Drilling Machine

The Multi-Angle Drill Corp., 1 West 34th St., New York, has placed on the market a portable radial drilling machine as shown in the illustrations.

This machine, Fig. 1, is intended for use in connection with any standard electric, pneumatic or hydraulic drills though these are not furnished with the machine except on special order. The regular equipment includes an adapter for connecting the feed screw to the body of any particular make of drill.

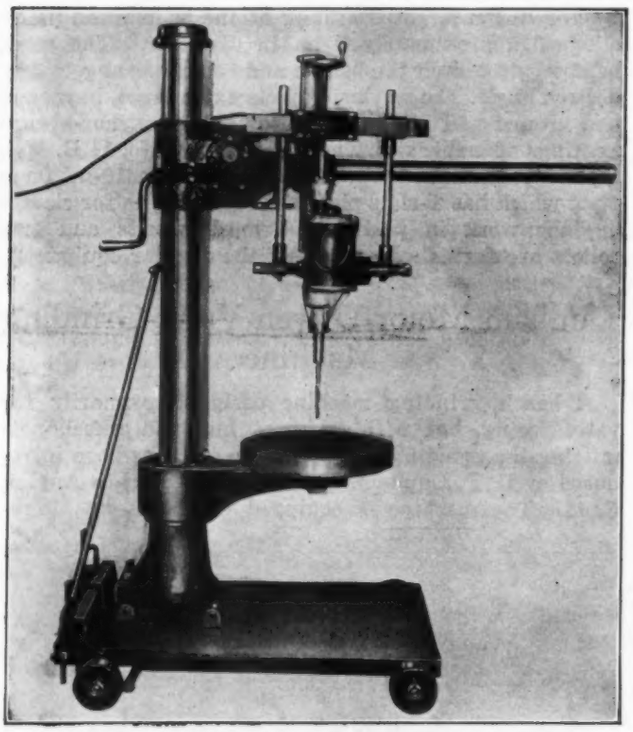


FIG. 1 MULTI-ANGLE PORTABLE RADIAL DRILLING MACHINE

Specifications: Base, 40 x 48 in.; total height, 6 ft. 6 in.; maximum height of drill above floor, 4 ft.; length of arm from center of column, 5 ft. 6 in.; diameter of table, 18 in.; center of table to center of column, 15½ in.; diameter of column, 4½ in.; diameter of arm, 3 in.; will drill holes up to 1 in.; weight complete, about 900 lb.

The base of the machine is mounted on wheels. The rear wheels are provided with steering knuckles controlled by the hauling tongue. This enables the machine to be turned and steered in very narrow places. Both the column and radial arm are made of Shelby tubing, ground to size, and so hinged that they can be folded for ease in transportation as shown in Fig. 2. An eyebolt in the top of the column affords means for hooking to a crane.

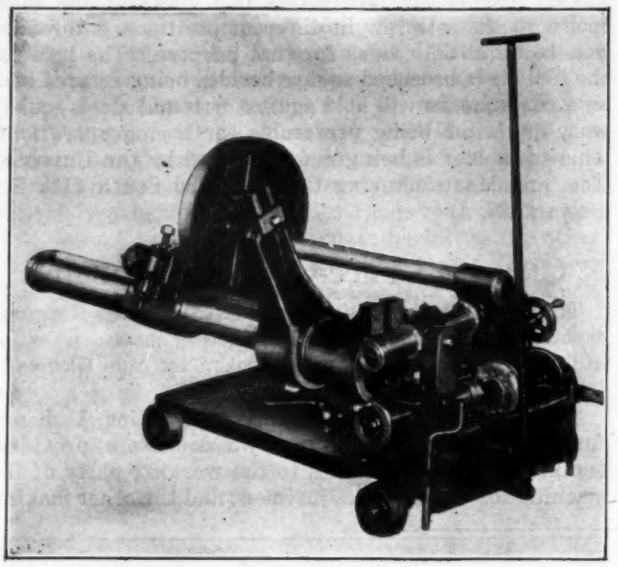


FIG. 2. MULTI-ANGLE DRILLING MACHINE FOLDED FOR EASE IN TRANSPORTATION

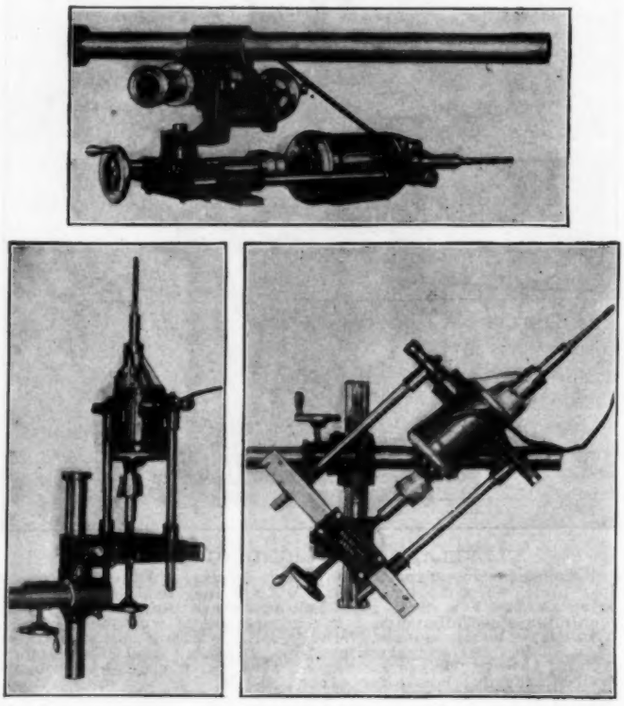
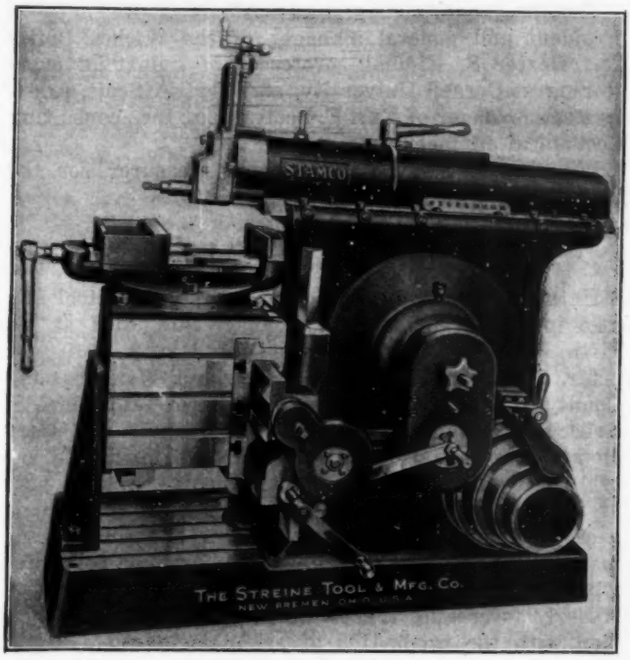


FIG. 3. SHOWING UNIVERSAL FEATURES OF MULTI-ANGLE DRILLING MACHINE

The arm is easily removable and can be replaced with one of any desired length. Chains can be attached for holding beams or other structural shapes for drilling while suspended. Two screws in the base reaching to the floor are used to steady the machine and prevent it from rolling when drilling is done in a horizontal direction. The head can be adjusted to drill in all directions and at any angle, some of the positions readily attainable being shown in the three photographs reproduced in Fig. 3.

"Stamco" Heavy-Duty Crank Shaping Machine

The 16-in., heavy-duty, back-geared, crank shaping machine, manufactured by the Streine Tool and Manufacturing Co., New Bremen, Ohio, has a base of the extended type, deeper than usual, and a large planed surface with T-slots running back to the column. The



"STAMCO" HEAVY-DUTY CRANK SHAPING MACHINE

Specifications: Length of stroke, 17 in.; crossfeed table, 24 in.; vertical feed of table, 15 in.; greatest distance, table to ram, 16 in.; size of tool, ⅞ x 1¼ in.; feed of tool, 7 in.; ram bearings in column, 10 x 34 in.; length of ram, 41 in.; bull gear bearing, 10 in. diameter; top of table, 17 x 14 in.; depth of table, 15 in.; keyseating capacity, 3 in.; vise jaws, 12 x 2¼ in.; opening of vise, 12⅛ in.; cone changes, four; machine belt, 2¾ in.; speeds of countershaft, 250 r.p.m.; size of countershaft pulleys, 12 x 4 in.; speeds to ram, eight; strokes per minute, 6 to 120; weight, approximately 3200 lb.; floor space, 41 x 82 in.; total height, 61 inches.

column is also of extra depth and width, and rigidly secured to the base, resulting in a machine with a low center of gravity. The bull gear bearing of large proportions is cast solid in the frame, thus avoiding wear caused by springing and friction, and is supported close to the rim by the frame itself, eliminating the tendency to bind or break away from the hub.

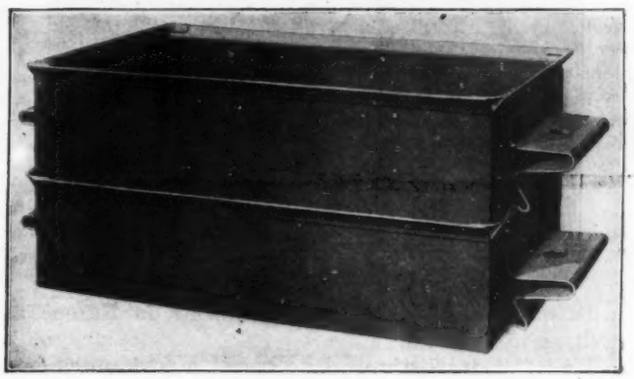
The crank block and its adjusting mechanism are set into the bull gear, for the purpose of reducing overhang between it and the rocker-arm to a minimum. This prevents chatter without the use of heavy, cumbersome working parts. The bull pinion has extended hubs, on which the intermediate gears are mounted, these rotating on bronze sleeves as in planing-machine construction. The driving gears are mounted on a long sleeve which slides on keys in the pulley shaft and is so arranged that speeds of the ram are in geometric progression, a construction that avoids conflicting gear ratios. The pulley bearing is bolted to the column, relieving the shaft of belt pull and eliminating an extra bearing. The ram and slide way, having extra length, are subject to very little wear, and the rail being clamped to the dovetail slide on the column, similar to milling-machine construction, insures accuracy in any position. The saddle fits into a narrow guide on the rail, equalizing the strain on the rail screw.

It may be noted from the illustration that the table can be readily removed, it being hooked over the saddle in such a way that the strain has a tendency to tighten the joint, relieving the table bolts of all thrust. The table support, owing to its location, is equally effective at any position of the rail or table. The elevating screw is of telescopic construction with ball thrust bearings and is out of the way of chips and dirt. The vise is of substantial construction and all adjustments, which are within easy reach of the operator, can be made while the machine is in motion. The feed can be varied or reversed and set to any desired degree and, owing to the absence of friction links, is constant at any position of the rail. All adjusting screws have micrometer collars graduated to 0.001, and as the head and vise are graduated in degrees they can be set to any desired angle.

Hauserman Stacking Tote Box

Tote boxes used as containers and for carrying small material are now considered as a necessary part of modern factory equipment. Various forms of these useful factory adjuncts have appeared at different times. The type illustrated is the product of the E. F. Hauserman Co., Cleveland, Ohio.

Two of the boxes are shown in stacked position to illustrate the provision for stacking which is due to the



HAUSERMAN STACKING TOTE BOXES

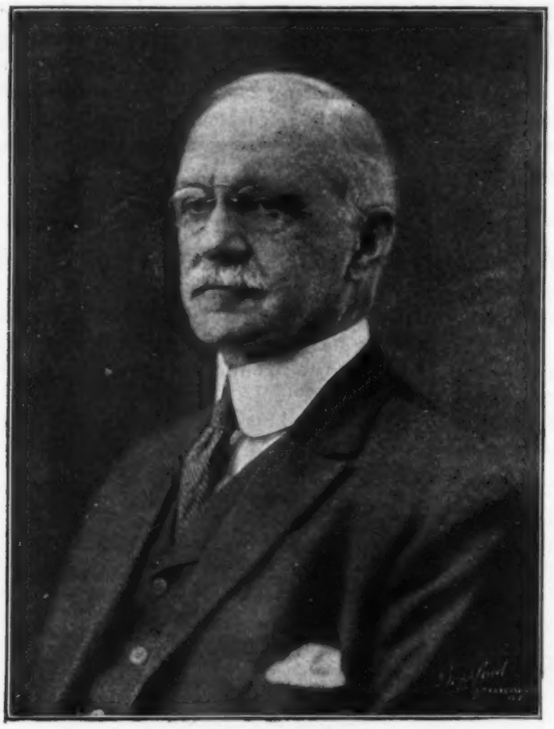
flanged opening that also serves to greatly strengthen the box. The flange is made by folding the metal back, making a double thickness that is welded. The inside corners are reinforced by 14-gage plates that are welded in place. The handles are of large size, affording a secure grip, and are designed as a protection against pinching the hands when stacking the boxes. The bottom is reinforced by two 1-in.-strap steel runners extending the full length, which allow the box to slide easily when drawn along the floor. The boxes are made in three sizes: 10 x 8 x 5 in, 12 x 20 x 5 in. and 12 x 24 x 6 in., these sizes meeting all requirements.

New Officers of the American Society of Mechanical Engineers

The *American Machinist* points with pride to the fact that Fred J. Miller, who was elected president of the American Society of Mechanical Engineers at the annual meeting in New York on Dec. 2, was its editor-in-chief for ten years.

Mr. Miller was born in Ohio in 1857. Upon leaving high school he served an apprenticeship of four years

in the machinist trade, and for a number of years worked in various capacities in machine shops. Early in his career he began contributing to mechanical journals and eventually dropped his work in the shop to join the editorial staff of the *American Machinist*. Ten years later he became editor-in-chief. He was also vice president of the Hill Publishing Co., which at that time was the publishing company. His work during this period naturally gave him an extensive acquaintance



FRED J. MILLER

with machinery-building establishments in Europe as well as in America.

He left journalistic work to accept a position as general manager of a group of typewriter factories. He had held this position nine years when the war broke out, and he promptly offered his services to the Government. A commission as Major of Ordnance in the U. S. Army was given him and he was first stationed at the Rock Island Arsenal, where he organized and was in charge of the Civilian Service Division. He was next attached to the office of the Director of Arsenals in Washington, being assigned to duty at the Bethlehem Steel Works; later in the office of the Secretary of War. Mr. Miller is now a member of the Technical Advisory Committee of the War Claims Board at Washington.

The new president became a member of the society in 1890 and has always taken an active interest in its affairs, having served on a number of important committees, and as a member of the council from 1904 to 1907, inclusive. He also served two terms as the society's representative on the Board of the United Engineering Societies, where he was chairman of three successive committees entrusted with the work of reorganizing and perfecting the Founder Societies' business affairs and finances. He was a member of the council at the time the *Journal* of the society was started, and has always been consulted on questions relating to its development, having recently devoted considerable time to the study of the society's publishing problems and its office methods and organization.

The three vice presidents elected were John Robins Allen, Robert H. Fernald and Edward C. Jones. Mr. Allen is dean of the College of Engineering and Architecture of the University of Minnesota; Mr. Fernald is professor of dynamical engineering at the University of Pennsylvania; Mr. Jones is chief engineer of the Pacific Gas and Electric Company.

The three new managers are Albert C. Fisher, vice president and general manager of the Wickes Boiler Co.; Dexter S. Kimball, professor of industrial engineering at Cornell University, and Earl F. Scott, president and manager of Earl F. Scott & Co., Inc., consulting mechanical engineers.

William H. Wiley was reëlected treasurer for the thirty-sixth time.

Henry Clay Frick

HENRY CLAY FRICK, a pioneer in the vast steel and coke industries in western Pennsylvania, died at his Fifth Ave. home in New York City, Dec. 2, 1919.

Mr. Frick was born in West Overland, Westmoreland County, Penn., Dec. 19, 1849, the son of John W. Frick and Elizabeth Overholt. His boyhood was spent on his father's farm and his education up to the age of 16 was obtained in the public schools. After a year at the Otterbein University in Ohio he entered upon a career that was to bring him fame and fortune and make his name one of the most familiar connected with the early history of the steel industries.

Early foreseeing the possibilities of coke in connection with the production of steel, he invested all the money he could muster in coal lands, and with the help of associates of his grandfather Overholt formed the corporation of Frick & Co. to deal in coke.

With the coming of the panic of '73 his partners became frightened and sought to dispose of their interests, but Frick with the optimism and determination which were characteristic of him, not only held on to what he had, but, by borrowing money, was enabled to acquire further holdings at a very low price so that when the inevitable reaction came he found himself a millionaire, at the age of 30 years.

In 1882 the business was reorganized under the name of H. C. Frick Coke Co., capitalized at two million dollars. Shortly after this he became associated with Andrew Carnegie. He figured prominently in the Homestead steel strike riots, as a result of which the anarchist Alexander Berkman seriously wounded him.

During the years immediately preceding 1900, Mr. Frick became involved in dissensions with Carnegie, and, though retaining his interests in the steel works, he retired from participation in their management, since when there is no evidence that he has taken an active interest in their affairs. He was also identified with the development of the Pennsylvania and the Philadelphia & Reading railroads, from which he realized large sums. His fortune is variously estimated from $75,000,000 to $100,000,000.

In private life Mr. Frick was rather quiet and unassuming, and dispensed much money in charities without attracting public attention. In 1915, upon the failure of a Pittsburgh bank, containing among other deposits the Christmas savings of 5000 children, Mr. Frick made good the children's losses. During the late war he gave largely to war charities, and was a liberal subscriber to the Government loans.

This is our delayed issue of Nov. 27—Dec. 4, 1919. This news is up to date, having been prepared for our Dec. 11 issue.

Sparks from Industry's Forge

Edited by E. C. Porter

First Sale Bulletin of Government Machine Tools

More than 2500 machine tools, representing a total cost of approximately $4,000,000, have been listed for sale by the machine-tool section of the Office of the Director of Sales in the first of a series of bulletin-catalogs to be issued semi-monthly by the machine-tool section.

The first bulletin of surplus Government-owned machinery contains a detailed description of every machine tool offered for sale, including the make, location, condition of the tools and the original cost to the Government. Among the tools listed are boring, broaching, drilling, milling, grinding, gear-cutting, screw, and sheet-metal-working machines; hammers, lathes, presses; small tools; riveting, slotting, and woodworking machines.

The contents of the bulletins will be revised and published two times a month, according to the plans as outlined by A. A. Fuller, chief of the machine-tool section. The trade is requested to direct inquiries to the district offices of the air service, ordnance, zone supply or signal corps listed in the bulletin.

* * *

Endowment Campaign of the Massachusetts Institute of Technology

In its present drive for an $8,000,000 endowment, the Massachusetts Institute of Technology, for the first time in its history, has gone outside the circle of its alumni in a concerted campaign for support. The popularity of the Institute, its high standards, its past record for excellent work and its research laboratories, its present efficient staff and superlative equipment, put it in the position of being able to offer genuine opportunities to industry. In this way it is putting its resources directly at the disposal of industry, and is opening a new era in the development of technical education in this country.

This endowment is being raised by means of contract between the Institute and various corporations. This contract calls for a yearly payment on the part of the corporation of a certain sum for a period of five years. The payment is in the nature of a retainer fee and carries with it the privileges of using the Institute library and files, and that of conferring with its technical staff on problems pertaining to the business of the contracting company. The Institute also agrees to advise and assist the company in obtaining the services of its alumni for special problems and permanent positions. Furthermore, in case the company has special technical problems requiring investigations, test or research, the Institute agrees to advise the company where this work can best be done, whether in its own laboratories by its own staff and students, or whether by some outside organization.

PRODUCTION depends upon the harmonious combination of workers, technical knowledge and capital. It is the fruit of these three elements. In order to be able to receive high wages, labor must be productive. Human effort must be directed and co-ordinated through the intelligence and technical knowledge of the head of the enterprise. Production must be increased by the use of machinery, which is provided by capital. Every increase in wages that does not carry with it a corresponding increase in production raises the cost of living. When every one realizes this point, most economic difficulties will have been solved and an important step will have been taken toward social progress.—*M. Eugene Schneider, head of the French delegation to the recent International Trade Conference, speaking on the present economic situation.*

To put it concisely, the Institute agrees to constitute itself a clearing house for industrial problems, problems both of investigation and personnel. With its large staff of highly trained experts, the Institute is able to command a range of technical information impossible to any one concern, no matter how complete its organization.

The work of pushing this contract is well under way. W. C. Potter, one of the partners of Guggenheim Bros., chairman of the industrial committee, reports that the American International Corp., the Chile Copper Co., the Simplex Wire and Cable Co., the Todd Shipbuilding Co. have already signed the contract, while the U. S. Rubber Co., the Goodyear Tire and Rubber Co., the Firestone Tire Co. have it under favorable consideration. For years the American Telephone and Telegraph Co. has had a contract with Technology calling for $15,000 a year; the General Electric has a coöperative course with the Institute, and, besides, has contributed $25,000 to the endowment fund. The Institute has also done extensive research work for the du Pont interests.

Trade Currents from Cleveland, Chicago and Philadelphia

CLEVELAND LETTER

Machinery manufacturing interests in the Cleveland district which have not already installed other facilities for operating their plants than by means of coal, are considering changing over at once to other fuel. Need for this decision has developed in the last few days as a result of the order of the Cleveland Federal Fuel Committee, which deprived industrial establishments of coal. The only institutions exempt from this order are public utilities, hospitals, homes and industrial establishments engaged in the production or preservation of food products. Officials of the industrial development committee of the Cleveland Chamber of Commerce have been appealed to, but they have been unable so far to have this order modified. The action indirectly is due to the decision of Ohio miners, numbering about 40,000, not to return to work until Washington has assured them some favorable decision as to their wage and hour demands. It is admitted in all industrial circles that even though normal production of coal were to start at once, it would take 30 days for the situation to straighten itself out.

Meanwhile machinery-producing interests are resorting to fuel-oil equipment for their heating requirements. At least one big establishment has already installed such facilities, and will not be endangered by a non-production situation. Natural gas is out of the question this year, as most of the manufacturing plants have long since been cut off from that supply. Many plants have access to power by electricity from outside their own establishments, but to conserve the fuel supply it is the belief of local fuel officials that Washington may issue an order forbidding its use. Meanwhile the present coal supply in manufacturers' hands is estimated to last until the end of the year at the longest. After that, shutdown of plants is looked for by some leaders in the industry, unless drastic changes in the situation develop before then.

On the other hand the steel situation continues to improve, conservative figures being that production is 70 per cent. of normal at the end of November. The machinery trade itself has not been affected by shortage of stocks, having sufficient surplus up to the present, and only in a few minor instances are producers affected by shortage of

castings to be supplied by mills in the Cleveland steel district. Other manufacturing interests, as consumers in machinery equipment, are not seriously affected, but the uncertainty as to getting sufficient stocks to carry on their plans has made for a curtailment in machinery requirements. This, combined with the usual inventory taking at this time, about a month earlier this year than in recent years, is making for a slow outlet for equipment at the moment.

There is plenty of small orders coming in, for a few individual needs, but nothing of the spectacular looked for even six weeks back. With anything like a further settlement of steel conditions, and of the fuel situation, machinery interests are of the belief that the turn of the year will see a tremendous demand setting in. This belief is based on the large number of feeling-out inquiries being made at this time.

One satisfactory development of the week is the announcement that British manufacturing interests are entering the Cleveland market for certain special equipment that cannot be obtained abroad, or apparently in other markets in this country. Several such orders were placed in one source during the week. This is not taken to indicate a revival of export business, but rather shows that if the equipment is available, it can find an outlet.

Chicago Letter

Machine-tool trade in this district continues excellent. Most dealers report sales as heavy this week as in any of the preceding busy weeks and the one or two dealers noting a slight falling off attribute it to the approaching holiday keeping out-of-town buyers at home. Business all through the fall has been phenomenal. Railroads and hotels report that traffic into and out of Chicago is almost double that of previous years and this is borne out by the number of shoppers from out of town who have been making purchases from machinery dealers in the recent months.

The Government sale of machine tools at the old Symington Corp.'s shell plant is in full swing. Thousands of tools of almost every variety are conveniently arranged on the great floor, each type of machine grouped together to facilitate selection. Many buyers, both consumers and dealers, are continually inspecting the stock but the established scale of prices is too high to be very attractive to dealers, and, when the fact is taken into consideration that the machines are sold "as is," with no guaranty of performance, the consumer does not find any bargains.

A uniform scale of prices has been adopted. In the case of new machines, prices are fixed at 80 per cent. of present market price and all used machines have been appraised and priced in accordance with their value in comparison with that of a new machine.

Tools to equip extensions and additions to existing plants continue to be the most prolific sources of orders to local dealers. The current month has seen the initiation of the following projects here in Chicago: a half-million dollar building for the Cadillac Motor Co. of Detroit, a $250,000 auto-repair establishment for a local man, a $200,000 plant for an automobile-spring manufacturer, a $350,000 hardware-manufacturing plant, a $150,000 plant for the American Type Foundry and Equipment Co., a $150,000 die-casting plant, an $80,000 motor factory, a $75,000 factory of electrical apparatus, a $75,000 factory of lighting equipment, a $50,000 factory of laboratory equipment, a $40,000 factory of light steam engines and a $25,000 lubricator factory. In each of these cases, the money mentioned is estimated to cover merely the cost of the building, and the

ONE OF THE FULLY EQUIPPED MACHINE SHOPS INCLUDED IN THE SALE OF U. S. SUPPLIES SOLD TO THE FRENCH GOVERNMENT

necessary machine equipment will run into many thousands of dollars.

Dealers anticipate a slump in orders placed during December, as is usually the case at the holiday season. So much goods is on back order, however, that an excellent business is assured from that source alone. About the only thing that can prevent 1919 going into the records as a banner year is a serious transportation tie-up, and that is not looked for.

PHILADELPHIA LETTER

Dealers in Philadelphia view the machine-tool industry, present and future, with varying degrees of optimism. For the most part business is reported to be very brisk and confidence is felt that the next two years will be the biggest in the history of the trade. A few dealers, however, feel that there is nothing unusual to report, that business is only fair, and that there are no trustworthy indications of much better times.

Despite high prices of materials small folks still demand new toys for Christmas, so dealers in woodworking machinery and jig saws have been fairly swamped with inquiries. Many of these inquiries have led to nothing, but a still greater number have resulted in orders of considerable size. In fact, several local dealers have been unable to satisfy the demand.

The price of machine tools, although fluctuating widely, has shown a steady rise. It may be said that the present cost of large tools is just about 12½ per cent. higher than that asked during the war. No appreciable falling off in sales can be attributed to this rise in price. Manufacturers recognize that if they must pay more for sugar, shoes and other essentials, then machinery, also, can be had only at an increased cost. In former times buyers of machinery were able to take their pick from the stocks displayed by various dealers, but now prospective purchasers seem willing to take whatever the dealer has on hand. This is especially true of machine tools of the heavier variety.

Delayed deliveries have sent many buyers to the Government sales of second-hand tools. Contrary to expectations, this has helped rather than retarded the sale of new equipment. Increased production has resulted from the first purchase, which has led the manufacturer to enter the machine-tool market for the second time, and this time for new equipment.

* * *

Winchester Repeating Arms Co. Buys Barney & Berry Skate Co.

The Winchester Repeating Arms Co., New Haven, Conn., has purchased the Barney & Berry Co., Inc., located at Springfield, Mass. The manufacture of skates will be continued, and the name of the concern will remain as heretofore, Barney & Berry, Inc. The new owners will put about $500,000 in the remodeling of the plant. At present the number of workmen at the factory will remain unchanged, but it is reported that additional men will be put on from time to time as the work progresses.

The new officers of the company are: President, R. Earl Anderson, now the treasurer of the Winchester Repeating Arms Co.; vice president and general manager, Herbert M. Wilcox, who is at present industrial engineer, at the Winchester plant. The directorate consists of the president and vice president; Henry Brewer, vice president and secretary of the Winchester Co.; James E. Wheeler, at present attorney of the Winchester Co.; and William E. Maxson, industrial engineer of the Winchester Co., and all from New Haven, Conn. David B. Hoar, of the law firm of McClintock & Hoar, of Springfield, will be clerk of the new company. Harry A. Hannum, who has been connected with the old concern for the past three years, will be superintendent of the new plant; and D. H. Brockett will be office manager.

University of Illinois Given $300,000 for the Study of Airplane Shafts

Thirty thousand dollars have been given to the University of Illinois from the research fund established by Ambrose Swasey, of Cleveland, Ohio, for research work in obtaining metal more resistant to the severe strain put upon crankshafts and other metal parts of an airplane than at present employed. Prof. H. F. Moore will have charge of this investigation.

Mr. Swasey, who established the fund, is a member of the Warner & Swasey Co., Cleveland, and in 1915 gave a fund of several thousand dollars, the income to be used for the advancement of arts and sciences connected with engineering. Last spring it was decided to center upon one major project, and the National Research Council, organized abroad to coördinate wartime scientific research, recommended the subject for investigation.

Domestic Exports of Metal-Working Machinery from the United States by Countries During May, 1919

Countries	491 Lathes	492 Other Machine Tools	493 Sharpening and Grinding Machines	495 All Other
Belgium	$107,089	24,690	31,243	195,234
Denmark	7,355	3,573	2,124	20,564
France	167,401	222,282	83,405	622,330
Iceland and Faroe Islands	.....	279	.....	.....
Italy	155	1,474	793	44,886
Netherlands	12,197	6,129	731	43,170
Norway	833	7,644	64	2,444
Portugal	.....	.....	.....	6,500
Spain	18,751	20,342	4,579	44,969
Sweden	15,119	2,346	21,626	30,617
Switzerland	290	64,011	741	20,930
England	171,465	252,889	80,003	267,181
Scotland	.....	8,198	.....	15,040
Canada	50,510	86,493	31,312	207,425
Costa Rica	.....	64	.....	.....
Guatemala	141	11	20	.....
Nicaragua	.....	.....	19	.....
Panama	1,170	546	70	21,349
Salvador	242	39	.....	.....
Mexico	1,273	2,041	1,657	2,648
Newfoundland and Labrador	.....	139	262	23
Barbados	.....	94	.....	.....
Jamaica	.....	235	46	75
Trinidad and Tobago	.....	.....	326	1,228
Other British West Indies	.....	50	.....	17
Cuba	19,518	41,817	1,810	13,558
Dutch West Indies	675	.....	.....	.....
French West Indies	.....	170	.....	.....
Haiti	19	.....	.....	50
Dominican Republic	250	174	.....	319
Argentina	11,888	7,390	1,693	26,432
Bolivia	.....	63	.....	30
Brazil	22,118	2,546	415	43,568
Chile	4,291	3,055	133	1,707
Colombia	575	250	938	626
Ecuador	.....	73	50	.....
British Guiana	.....	33	.....	.....
Paraguay	.....	19	155	.....
Peru	537	293	276	2,162
Uruguay	1,185	375	.....	.....
Venezuela	530	309	148	156
China	32,272	10,390	5,800	25,216
Japanese China	.....	.....	.....	220
British India	3,576	1,462	3,171	11,487
Straits Settlements	.....	.....	.....	155
Dutch East Indies	14,920	4,087	112	2,740
French East Indies	.....	.....	50	296
Hongkong	6,850	.....	8	1,401
Japan	37,155	41,459	31,297	271,127
Russia in Asia	.....	50	249	15,351
Siam	23	.....	.....	.....
Australia	7,012	12,832	5,118	5,505
New Zealand	.....	2,230	833	1,336
Other British Oceania	.....	.....	73	.....
French Oceania	.....	.....	11	104
German Oceania	.....	.....	.....	130
Philippine Islands	960	3,879	821	4,422
Belgian Kongo	.....	56	.....	.....
British South Africa	6,615	5,375	1,290	15,912
French Africa	.....	.....	109	.....
Egypt	.....	.....	.....	365
Total	724,960	841,956	313,581	1,991,005

Westinghouse War Memorial Scholarships Awarded

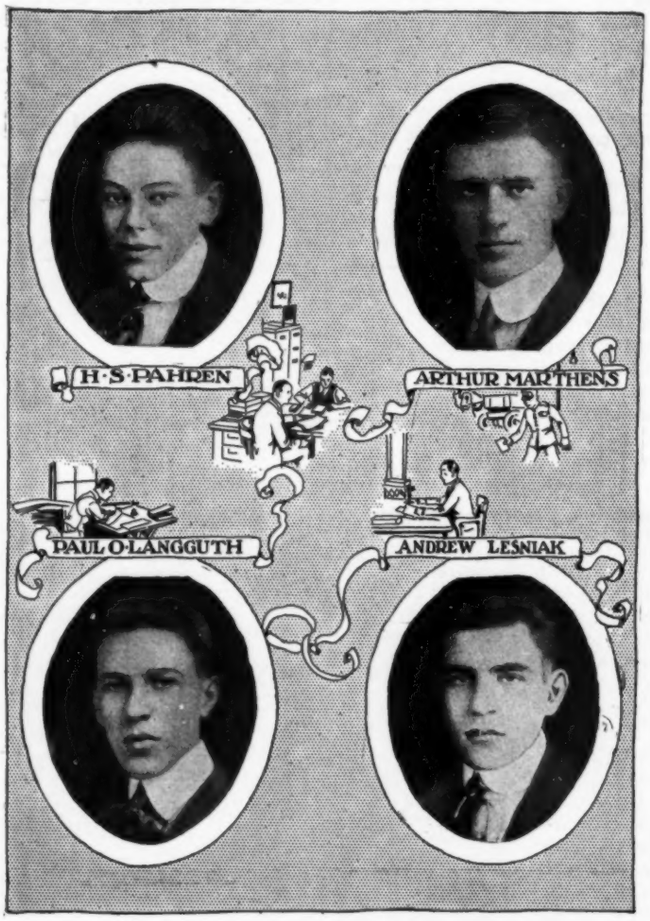
The awards of the four annual war memorial scholarships of five hundred dollars each, established by the Westinghouse Electric and Manufacturing Co., have been announced. These awards were made by competitive examinations and the following men were successful:

Herbert S. Pahren, Cincinnati, Ohio, employed as order clerk in the Cincinnati office of the Westinghouse company and a graduate of the Hughes High School, who has selected for his scholarship a technical engineering course at the University of Wisconsin.

Arthur Marthens of East Pittsburgh, Penn., began work as a messenger boy before completing his studies in the Turtle Creek Schools. Mr. Marthens, while working in the cost department, prepared himself in the Casino Technical Night School to enter college. He has chosen a course in electrical engineering at the Carnegie Institute of Technology.

Paul O. Langguth, a graduate of the Wilkinsburg High School and employed as draftsman in the engineering department at East Pittsburgh, has selected as his award an electrical engineering course at the University of Pittsburgh.

Andrew P. Lesniak, a graduate of the Union High School, Turtle Creek, Penn., and employed in the production department at East Pittsburgh, has selected a course in mechanical engineering at the University of Pittsburgh.



Two classes of scholarships are provided: One for sons of employees of the company or its subsidiaries who have been employed for five years or longer; the other for employees of the company and its subsidiaries who have been continuously employed for at least two years and who shall not, on Sept. 1, have exceeded the age of 23. Not more than two class B scholarships will be awarded in any year.

Each scholarship carries with it an annual payment of five-hundred dollars for a period not to exceed four years, the payment to be applied toward an engineering education in any technical school or college selected by the successful candidate with the approval of the scholarship committee.

These scholarships have been established as a memorial to those employees of the company and its subsidiaries who entered the service of their country during the war. Four awards will be made each year, so that after three years this company will be maintaining 16 of these scholarships in the best technical schools of the United States.

The Singer Co. Will Burn Fuel Oil Instead of Coal

The Singer Manufacturing Co., manufacturer of the "Singer" sewing machine, with a factory located at Bridgeport, Conn., has announced, through the general manager, George M. Eames, the complete installation of oil-burning apparatus as a fuel instead of coal, at the Bridgeport plant. Oil fuel will be used for the entire plant, and the company contemplates a large storage tank on the Yellow Mill pond, for the storage of about 500,000 gal. of Mexican petroleum. The oil will also do away with the smoke nuisance caused by coal fuel.

* * *

Will Build Houses for Workmen

The Whitin Machine Works, Whitinsville, Mass., manufacturers of cotton-mill machinery of all kinds, will erect about 75 houses for its workmen on a 20-acre tract of land near the plant. New sewers and water mains will be installed, and new gravel roadways will be constructed. The company has just completed a large boarding house.

* * *

Manufacturing Machine Tools

The Lake Shore Engine Works, Marquette, Mich., is now manufacturing machine tools. The company recently contracted to build twenty-five 5-ft. radial drilling machines and six planing machines, 4 x 16 ft.

Business Items

Torris Wold & Co., Chicago, Ill., has recently changed its name to the Camcron Can Machine Co. The ownership, location and personnel remain the same.

The Worcester Lathe Co., formerly located at 68 Prescott St., Worcester, Mass., has taken new quarters at 35 Hermon St. Alonzo W. Whitcomb is the owner.

The Melton-Rhodes Co., Greensboro, N. C., has acquired the plant of the Southern Car Co., and will shortly move its plant to this place. The company manufactures filing cabinets and office specialties.

The Mechanics Machine Co., Rockford, Ill., has acquired the plant of the National Mirror Works, located directly north of the machine factory. The Mirror Works is building an enlarged plant in another factory district.

The Black & Decker Manufacturing Co., has opened an additional office on the Pacific Coast, at 201 Maynard Building, Seattle, Wash. This office is in charge of A. E. Nordwall, who will have charge of the distribution of Black & Decker products in the State of Washington, working under the direction of the main Pacific Coast office, 918 Hearst Building, San Francisco, Calif.

The Waterloo Gasoline Engine Co., Waterloo, Ia., now owned by Deers & Co., Moline, Ill., has signed contracts for new buildings and improvements aggregating an expenditure of $125,000. Among these will be storage and shipping facilities for 500 tractors and an equal amount of repair parts. A garage for employees' automobiles to accommodate 75 cars will be built also. A. H. Head of the home office at Moline is now general manager at the Waterloo factory.

The Master Tool Co., Providence, R. I., has been organized to manufacture tools, etc., with a capital stock of $25,000. The incorporators are William D. Grady, Woonsocket; Joseph Duplessie and Henry C. Hart, of Providence. The latter's address is 926 Grosvenor Building, Providence. The new concern will commence business immediately.

The Standard Steel and Bearings, Inc., a new corporation, has purchased a large tract of land on West Main and Canal Sts., Plainville, Conn., where a new plant is contemplated.

The Norton Co., of Worcester, Mass.,

has appointed Francis J. Reilly, publicity man, to succeed Russell S. Coe, who has resigned on account of ill health, returning to his home in Connecticut. Mr. Reilly was formerly with the United States Aircraft Production Board, and previous to that was connected with the advertising department of the Brown & Sharpe Manufacturing Co., at Providence, R. I.

The Monarch Machinery Co., Philadelphia, has acquired the agency to handle the sales of the Cincinnati shaping machine, the Cincinnati gear cutting machine, and the Cincinnati grinding machine in Pennsylvania.

The Wilmarth & Morman Co., Grand Rapids, Mich., manufacturer of grinding machinery, has established an eastern branch office at No. 1 Madison Ave., New York. W. E. Heibel, eastern district manager, will be in charge.

Personals

I. C. SCOVILL has resigned his position as sales manager of the Collis Co., Clinton, Ia., to accept a position as sales manager for the Detroit Reamer and Tool Co., Detroit, Mich.

ALLEN F. SMITH, formerly with the Carlton Engraving Co., Worcester, Mass., has been appointed by the Walden-Worcester, Inc., Worcester, Mass., as advertising manager.

RALPH B. DIBBLE, formerly with the Packard Motor Car Co., has been appointed by the Graton and Knight Manufacturing Co., Worcester, Mass., as sales assistant in charge of the advertising.

C. C. PHELPS, formerly publicity man with the Oxweld Acetylene Co., Newark, N. J., is now with the Uehling Instrument Co., maker of power-plant apparatus. Its office is at 71 Broadway, New York.

FREDERICK A. HARDIN, formerly with Oliver H. Van Horn, New Orleans, La., has been appointed Southern representative for the Victor Saw Works, Springfield, Mass. Mr. Hardin succeeds E. C. Paddock who has been transferred to the Middle West.

L. C. GRIFFIN, who was formerly the Baltimore representative of the Norton Co., Worcester, Mass., manufacturer of grinding machinery, has been appointed to the position of district manager, with offices at Philadelphia. Walter Strong, of Philadelphia, succeeds Mr. Griffin at Baltimore.

JESSE R. FIFER has opened a consulting engineer office at 298 Broadway, New York. Mr. Fifer was for eight years a designer in the Ordnance Bureau of the War Department. From July, 1915 to June, 1917, he was chief draftsman for the International Arms and Fuse Co., Bloomfield, N. J., and from June, 1917, to Oct. 25, 1918, he was Captain of Ordnance, and served on the staff of the Chief of Ordnance at Tours, France.

Watson Machine Works To Be Taken Over by New Incorporation

The Ceramic Equipment Co., Trenton, N. J., has been incorporated with $100,000 capital stock and will take over the old Watson Machine Works, where machinery will be installed for the manufacture of clay and chemical drying machines. The new company plans to install new machinery. The incorporators are David Crossley, president of the Crossley Machine Co.; Donald M. Miller, secretary of the same company; former Senator Harry D. Leavitt and Joseph L. Buckley, all of Trenton. The company will manufacture the Buckley system of porcelain machinery.

* * *

Bridgeport Manufacturers' Association Elects Officers

At the annual meeting of the Bridgeport, Conn., Manufacturers' Association, at the Stratfield Hotel, on Nov. 18, the following officers were reëlected: Clarence E. Bilton, of the Bilton Machine Tool Co., president; Waldo C. Bryant, of the Bryant Electric Co., and the Perkins Electric Switch Manufacturing Co., first vice president; Walter B. Lashar, of the American Chain Co., second vice president; J. H. Collier, of the Crane Co., treasurer; F. A. Bennett, secretary.

FRANK O. WELLS, president of the Greenfield Tap and Die Corp., Greenfield, Mass., has returned recently from a business trip through the European countries. While in Europe, Mr. Wells visited a number of the battlefields of France and Belgium.

ROBERT F. HERRICK, president of the Reed-Prentice Co., Worcester, Mass., manufacturer of machine tools and machinery, accompanied by his son, Robert F., Jr., has gone on a business trip to Europe.

C. L. SMITH, for several years Cincinnati editor of *Iron Age*, with offices in the Mercantile Library Building, has resigned to take the selling agency for the Red Cut Superior and other steels made by the Vanadium-Alloys Steel Co. Mr. Smith assumed his new duties Dec. 1, making Cincinnati his headquarters.

EDGAR REED, president of the Reed & Prince Manufacturing Co., Worcester, Mass., manufacturer of wood and machine screws, taps and dies, etc., has returned to Worcester, after a three months' trip through Europe. Mr. Reed visited many battlefields of the recent World War.

FREDERICK H. KORFF has recently assumed his new duties as factory manager of the modern plant for the manufacture of gages purchased by the C. E. Johansson, Inc., at Poughkeepsie, N. Y. Mr. Korff is a Pratt Institute and Columbia University man. He has held the positions of factory manager for H. C. Hinchcliff, Inc.; production manager and mechanical engineer of Frank S. Betz Co.; assistant general superintendent and production manager of the Stromberg Carburetor Co.; and more recently as assistant factory manager in the several plants of the Wright-Martin Aircraft Corp., makers of the Hispaño-Suiza airplane motor.

Obituary

JOHN F. BARKER, former president of the Gilbert & Parker Manufacturing Co., Springfield, Mass., died Nov. 21. Mr. Barker was born in Newton Upper Falls, Mass., Dec. 16, 1839. He moved to Springfield in 1862 and was employed in the water shops of the United States Armory, where he remained until the forming of the Gilbert & Barker Manufacturing Co., in 1865. He was treasurer and manager of the company until 1884, when he was elected president. He retired in 1911.

T. WHITNEY BLAKE, president of the Whitney-Blake Co., New Haven, Conn., manufacturer of rubber goods for electrical purposes, died suddenly at his New York home on Thanksgiving day. Mr. Blake appeared to be in the best of health on the eve of Thanksgiving, and retired in the best of spirits. He was found dead in bed Thanksgiving morning.

Forthcoming Meetings

The American Welding Society will hold a special meeting on Friday, Dec. 12, in the Engineering Societies Building, 29 West 39th St., New York. This meeting takes the place of the regular November and December meetings, the dates of which conflicted with holidays.

The Society of Automotive Engineers will hold its annual meeting in New York on Jan. 6 to 8, 1920.

Boston Branch, National Metal Trades Association. Monthly meeting on first Wednesday of each month, alternating with the Employers' Association of eastern Massachusetts. George D. Berry, secretary, room 50-51, 166 Devonshire St., Boston, Mass.

Engineers' Club of Philadelphia. Regular meeting the third Tuesday of the month. Lewis H. Kenney is the chairman of committee on papers.

Electric Hoist Manufacturers' Association. Monthly meeting at the offices of the Yale & Towne Manufacturing Co., 9 East 40th St., New York City. Secretary W. C. Briggs, Shepard Electric Crane and Hoist Co.

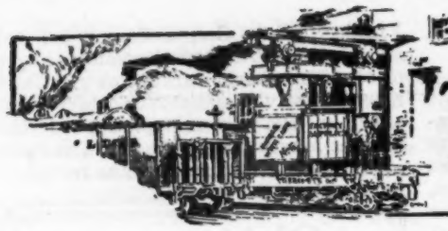
Engineers Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

The motor-truck sections of the 20th Annual Automobile Shows of 1920 will hold an exhibition in the 8th Coast Artillery Armory, New York, Jan. 3 to 10, 1920, and in the International Amphitheatre, Chicago, Ill., Jan. 24 to 31, 1920.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn., Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Rochester Society of Technical Draftsmen. Monthly meeting last Thursday, O. L. Angevine, Jr., secretary, 547 Arnett Boulevard, Rochester, N. Y.

The Society of Automotive Engineers will hold its annual meeting in New York on Jan. 6 to 8, inclusive. For further information of program, address the meeting committee, 239 West 39th St.



THE WEEKLY PRICE GUIDE

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co., as per Department of Commerce Committee Schedule.

	Current	One Month Ago
CINCINNATI		
No. 2 Southern	$36.60	$30.35
Northern Basic	34.00	27.55
Southern Ohio No. 2	36.55	28.55
NEW YORK—TIDEWATER DELIVERY		
2X Virginia (Silicon 2.25 to 2.75)	39.40	32.40
Southern No. 2 (Silicon 2.25 to 2.75)	41.40	35.20
BIRMINGHAM		
No. 2 Foundry	33.00	29.75
PHILADELPHIA		
Eastern Pennsylvania No. 2	38.10*	29.30
Virginia No. 2	39.10*	33.10
Basic	34.60†	26.75
Grey Forge	34.60*	26.25
CHICAGO		
No. 2 Foundry local	36.25	26.75
No. 2 Foundry, Southern	38.00	28.00
PITTSBURGH, INCLUDING FREIGHT CHARGE FROM VALLEY		
No. 2 Foundry	.....	28.15
Basic	34.40	27.15
Bessemer	35.40	29.35

* F. o. b. furnace. Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$3.47	$3.47	$4.245	$3.37	$4.17	$3.47	$4.27
Soft steel bars	3.52	3.37	4.145	3.27	4.07	3.52	4.17
Soft steel bar shapes	3.52	3.37	4.145	3.27	4.17	3.52	4.17
Soft steel bands	4.22	4.07	4.995	.....	.....	.....	.....
Plates, ¼ to 1 in. thick	3.67	3.67	4.495	3.57	4.42	3.67	4.25

[Note—For less than carload lots, add 4½c. per 100 lb.

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Mill, N. Y.	$3.10	$3.50
Warehouse, New York	3.52	4.75
Warehouse, Cleveland	3.42	4.67
Warehouse, Chicago	3.52	4.10

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the base quotations from mill:

	Mill, Carloads, Pittsburgh	New York Current	New York One Year Ago	Cleveland	Chicago
No. 28 black	$4.35	$6.00	$6.52	$5.77	$6.00
No. 26 black	4.25	5.90	6.42	5.67	5.90
Nos. 22-24 black	4.20	5.85	6.37	5.62	5.85
Nos. 18-20 black	4.15	5.80	6.32	5.57	5.80
No. 16 blue annealed	3.75	5.02	5.52	5.17	5.02
No. 14 blue annealed	3.65	4.92	5.42	5.07	4.92
No. 10 blue annealed	3.55	4.82	5.32	4.97	4.82
No. 28 galvanized	5.70	7.25	7.77	7.12	7.25
No. 26 galvanized	5.40	6.95	7.47	6.82	6.95
No. 24 galvanized	5.25	6.80	7.32	6.57	6.52

COLD FINISHED STEEL—Warehouse prices are as follows:

	New York	Chicago	Cleveland
Round shafting or screw stock, per 100 lb. base	$5.00	$4.90	$4.75
Flats, square and hexagons, per 100 lb. base	5.50	5.40	.....

DRILL ROD—Discounts from list price are as follows at the places named:

	Per Cent.
New York	55
Cleveland	50
Chicago	50

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots is:

	Current	One Year Ago
New York	$21.00–26.00	$15.50–1900
Cleveland	20.00	20.00
Chicago	16.50	19.00

In coils an advance of 50c. usually is charged.
Domestic iron (Swedish analysis) is selling at 15c. per lb.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100 lb. lots and over:

Welding Wire		Cast-Iron Welding Rods	
¼, 5/16, ⅜, 7/16, ½	21.00 to 30.00	¼ by 12 in. long	14.00
No. 8, 9/16 and No. 10		¼ by 19 in. long	12.00
⅝		⅜ by 19 in. long	10.00
No. 12		⅜ by 21 in. long	10.00
¾, No. 14 and 13/16		Special Welding Wire, Coated	
No. 18		½	33.00
No. 20		9/16	30.00
		⅝	38.00

Domestic 20c. for 5/16, 15c. for ¼ to ⅜

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	6.00	8.00	8.00
Spring steel (light)	8.00	10.00	10.00
Coppered bessemer rods	8.00	8.00	6.75
Hoop steel	4.47	4.75	4.07
Cold-rolled strip steel	8.40	8.25	7.50
Floor plates	5.67	6.00	5.92

Note—For less than carload lots, add 4½c. per 100 lb.

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of National Tube Co. for steel pipe, Cardry A. M. Byer's Co. for iron, both dated Mar. 21, 1919.

BUTT WELD

Inches	Steel Black	Steel Galvanized	Inches	Iron Black	Iron Galvanized
⅛, ¼ and ⅜	50½%	24%	⅜ to 1¼	30%	23½%
½	54½%	40%			
¾ to 3	57½%	44%			

LAP WELD

2	50½%	35%	2	32½%	18½%
2½ to 6	53½%	41%	2½ to 6	34½%	21½%

BUTT WELD, EXTRA STRONG PLAIN ENDS

⅛, ¼ and ⅜	46½%	29%	½ to ¾	39½%	24½%
½	51½%	39%			
¾ to 1¼	55½%	43%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	48½%	37%	2	33½%	20½%
2½ to 4	51½%	49%	2½ to 4	.....	23½%
4½ to 6	50½%	39%	4½ to 6	34½%	22½%

Stock discounts in cities named are as follows:

	Black	Galv.	Black	Galv.	Black	Chicago Galv.
¼ to 3 in. steel butt welded	47%	31%	43½%	34½%	57½%	44%
2½ to 6 in. steel lap welded	42%	27%	45½%	39½%	53½%	41%

Malleable fittings. Class B and C, banded, from New York stock sell at plus 12½% less 50%. Cast iron, standard sizes, 10–5% off.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	18.25	21.25	26.00
Tin in 5-ton lots	54.00	56.00	83.00
Lead	6.75	6.75	8.05
Spelter	8.45	7.90	9.50
ST. LOUIS			
Lead	6.55	6.50	7.75
Spelter	8.10	7.55	9.25

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

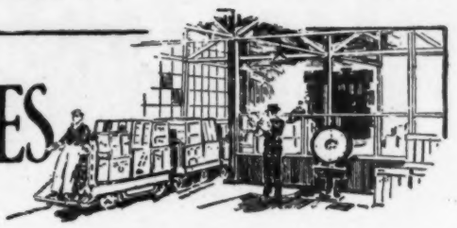
	New York Current	New York Month Ago	New York Year Ago	Cleveland Current	Cleveland Year Ago	Chicago Current	Chicago Year Ago
Copper sheets, base	28.50	33.50	38.00	31–32.50	34.00	36.00	38.00
Copper wire (carload lots)	28.00	29.00	39.75	30.00	36.00	26.00	38.00
Brass sheets	25.50	32.00	39.75	28.00	32.00	28.00	38.00
Brass pipe	30.50	36.00	46.00	34.00	42.00	37.00	44.00
Solder (half and half) (case lots)	35.00	45.00	58.00	35.00	50.50	33.00	65.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill. 100 lb. and over, warehouse; net extra:

	Current	One Year Ago
Mill	22.75	37.75
New York	24.00	34.25
Cleveland	26.00	38.50
Chicago	27.00	29.50

SHOP MATERIALS AND SUPPLIES



ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill 11.00

	In Casks		Broken Lots	
	Current	One Year Ago	Current	One Year Ago
Cleveland	11.50	20.00	12.00	20.50
New York	11.00	21.00	11.50	21.25
Chicago	15.00	21.00	15.00	21.50

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots for spot delivery, duty paid:

	Current	One Year Ago
New York	9.25	12.50
Chicago	9.50	15.00
Cleveland	11.75	16.00

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	New York		Cleveland		
	Current	One Year Ago	Current	One Year Ago	Chicago
Copper, heavy and crucible	17.50	24.00	18.50	24.75	16.50
Copper, heavy and wire	15.50	22.50	19.00	24.00	16.25
Copper, light and bottoms	13.50	20.50	16.00	22.00	15.25
Lead, heavy	6.25	7.25	5.00	7.50	6.00
Lead, tea	5.00	5.50	3.50	7.50	5.00
Brass, heavy	9.00	14.75	15.50	17.00	16.00
Brass, light	8.00	11.00	10.00	13.00	9.50
No. 1 yellow brass turnings	9.50	13.75	11.50	14.00	10.00
Zinc	5.00	6.50	5.00	6.00	6.00

ALUMINUM—The following prices are from warehouse at places named:

	New York	Cleveland	Chicago
No. 1 aluminum, 98 to 99% pure, in ingots for remelting (1-15 ton lots), per lb	33.00c.	32.00c.@35.00c.	33½c.

COPPER BARS—From warehouse sell as follows in cents per pound, for ton lots and over:

	Current	One Year Ago
New York (round)	34.00	32.00
Chicago	30.00	38.00
Cleveland	33.50	36.50

BABBITT METAL—Warehouse price per pound:

	New York		Cleveland		Chicago	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Best grade	90.00	95.00	70.00	93.00	60.00	96.00
Commercial	55.00	50.00	16.50	23.00	13.00	25.00

SHOP SUPPLIES

NUTS—From warehouse at the places named, on fair-sized orders, the following amount is deducted from list:

	New York		Cleveland		Chicago	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Hot pressed square	List	+$2.50	$2.25	$1.20	$1.45	$0.98
Hot pressed hexagon	List	+ 2.50	2.25	1.00	1.45	.78
Cold punched hexagon	List	+ 2.50	2.25	.75	1.05	1.00
Cold punched square	List	+ 2.50	2.25	.75	1.05	1.00

Semi-finished nuts sell at the following discounts from list price:

	Current	One Year Ago
New York	70–5%	40%
Chicago	50%	50%
Cleveland	60–10%	50–10%

MACHINE BOLTS—Warehouse discounts in the following cities:

	New York	Cleveland	Chicago
½ by 4 in. and smaller	40%	50%	35–5%
Larger and longer up to 1½ in. by 30 in.	30%	40%	25–5%

WASHERS—From warehouses at the places named the following amount is deducted from list price:

For wrought-iron washers:

New York..... $1.25 Cleveland..... $3.75 Chicago..... $3.00

For cast-iron washers the base price per 100 lb. is as follows:

New York..... $7.00 Cleveland..... $3.75 Chicago..... $4.25

CARRIAGE BOLTS—From warehouses at the places named the following discounts from list are in effect:

	New York	Cleveland	Chicago
½ by 6 in. and smaller	35%	40–5%	30%
Larger and longer up to 1 in. by 30 in.	25%	37½%	20%

COPPER RIVETS AND BURS sell at the following rate from warehouse.:

	Rivets		Burs	
	Current	One Year Ago	Current	One Year Ago
Cleveland	30%	List plus 10%	30%	List plus 10%
Chicago	20%	List price	20%	List plus 20%
New York	30%	20% from list	10%	List plus 20%

RIVETS—The following quotations are allowed for fair-sized orders from warehouse:

	New York	Cleveland	Chicago
Steel ½ and smaller	50%	55% off	50%
Tinned	50%	55% off	50%

Boiler, ½, ¾, 1 in. diameter by 2 to 5 in. sell as follows per 100 lb.:

New York...$5.00 Cleveland...$4.00 Chicago....$4.87 Pittsburgh....$4.72

Structural, same sizes:

New York...$5.10 Cleveland...$4.10 Chicago....$4.97 Pittsburgh....$4.82

MISCELLANEOUS

SEAMLESS DRAWN TUBING—The base price in cents per pound from warehouse in 100-lb. lots is as follows:

	New York	Cleveland	Chicago
Copper	32.00	36.00	38.50
Brass	30.50	34.00	37.00

For immediate stock shipment 3c. is usually added. The prices, of course, vary with the quantity purchased. For lots of less than 100 lb., but not less than 75 lb., the advance is 2c.; for lots of less than 75 lb., but not less than 50 lb., advance is 5c. over base (100-lb. lots); less than 50 lb., but not less than 25 lb., 10c. should be added to base price; quantities from 10-25 lb., extra is 25c.; less than 10 lb., add 35c.

Double above extras will be charged for angles, channels and sheet metal mouldings if ordered in above quantities. Above extras also apply to brass rod other than standard stock sizes—stock sizes being considered as ⅛-2 in. inclusive in rounds, and ⅛-1½ in., inclusive, in square and hexagon—all varying by thirty seconds up to 1 in. by sixteenths over 1 in. On shipments aggregating less than 100 lb., there is usually a boxing charge of $1.50.

COTTON WASTE—The following prices are in cents per pound:

	NEW YORK			
	Current	One Year Ago	Cleveland	Chicago
White	13.00	1.00–13.00	14.00	11.00 to 14.00
Colored mixed	9.00 to 12.00	8.50–12.00	11.00	9.50 to 12.00

WIPING CLOTHS—Jobbers' price per 1000 is as follows:

	13½x13½	13½x20½
Cleveland	52.00	58.00
Chicago	41.00	43.50

SAL SODA sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$2.25	$1.75	$1.75
Philadelphia	2.00	1.75	1.75
Cleveland	2.50	2.50	2.40
Chicago	2.00	2.00	2.00

ROLL SULPHUR in 360-lb. bbl. sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$3.40	$3.65	$4.30
Cleveland	3.875	3.875	4.60
Chicago	4.12½	4.125	4.00

COKE—The following are prices per net ton at ovens, Connellsville:

	Dec. 2	Sept. 18
Prompt furnace	$7.00	$4.60
Prompt foundry	6.50	6.00

FIRE CLAY—The following prices prevail:

		Current
Ottawa, bulk in carloads	Per Ton	$8.00
Cleveland	375-lb. bag	2.50

LINSEED OIL—These prices are per gallon:

	New York		Chicago	
	Current	One Year Ago	Current	One Year Ago
Raw in barrels (5 bbl. lots)	$1.80	$1.61	$1.98	$1.65
5-gal. cans	1.93	1.76	2.23	1.85

WHITE AND RED LEAD—Base price per pound:

	Red				White			
	Current		One Year Ago		Current		One Year Ago	
	Dry	In Oil	Dry	In Oil	Dry and In Oil		Dry and In Oil	
100 lb. keg	13.50	15.60	14.00	14.50	13.50		14.00	
25 and 50-lb. kegs	13.75	15.25	14.25	14.75	13.75		14.25	
12½-lb. keg	14.00	15.50	14.50	15.00	14.00		14.50	
5-lb. cans	15.50	17.00	.....	.....	15.50		16.00	
1-lb. cans	16.50	18.00	.....	.....	10.65		17.00	

NEW AND ENLARGED SHOPS

Consult the Buying Section when in need of machinery or supplies

Machine Tools Wanted

The following concerns are in the market for machinery and machine tools.

Md., Hagerstown—The Security Cement and Lime Co., 116 West Washington St.—one 20 to 30 ton standard gauge four wheel saddle tank locomotive and one 75 to 90 ton railroad type standard gauge steam shovel for rock work and with air compressor equipment.

N. J., Newark—Kraeuter & Co., 583 18th Ave.—hammer, upright helve, to 300 lb. capacity (used).

N. Y., New York (Borough of Manhattan)—The Modern Machinery Exchange, 25 Church St.
One No. 2 bulldozer.
One ¾ in. Cleveland automatic single spindle.
One 2 in. Cleveland automatic single spindle.
One No. 1 Sloan & Chase gear cutter.
One No. 1 Brown & Sharpe automatic screw machine.
One No. 3 Barber & Coleman gear bobber.
One 4 in. gear cutter.
One 10 ft. vertical boring mill.
One 350 lb. drop hammer.
One 54 x 54 x 18 in. two head open side planer.
One No. 54 National Acme screw machine.
One 48 in. shear to handle ¼ in. plates.
One single end power punch with 24 in. throat.
One American or Lodge & Shipley lathe, 10 to 12 ft. bed, 20 to 24 in. swing.
One pair 6 ft. power rolls to handle ¾ in. plates.

N. Y., Rochester—A. G. Stevenson, 161 Champlain Ave.—No. 1 and a No. 2 Brown and Sharpe automatic screw machines, (used).

Penn., Philadelphia—The K & B Co., 497 North 3rd St.—milling cutters of all sizes.

Penn., Philadelphia—The Wiccao Machine Screw Co., 7th and Wood St., will soon award the contract for the construction of a 2 story, 82 x 274 ft. factory.

Ill., Chicago—The A. D. White Machinery Co., 108 North Jefferson St.—One 84 in. open side planing machine with any length bed, a 6 ft. full universal radial drill and a 5 in. bar, horizontal boring drilling and milling machine, (new machines preferred).

Ill., Chicago—D. A. Wright, 568 Washington Blvd.—hand power plate shear for ¼ in. plate, and plate bending roll 78 to 120 in. capacity ⅜ in. plate.

Mich., Benton Harbor—The Benton Harbor Malleable Foundry Co., Graham St.—Two stage air compressor of 450 cu.ft. or greater capacity.

Mich., Flint—City Water Dept.—truck repair shop equipment.

Mich., Marquette—The Charcoal Iron Co. of America—36 in. radial drill.

Ohio, Akron—The Wildley Machine and Manufacturing Co.—7 in. shaper.

Ohio, Cincinnati—The Carlton Machine Tool Co., Spring and Meeker St.—several boring mills, broaching machines and lathes (used).

Ohio, Cleveland—The Atlas Car and Manufacturing Co., 1144 Ivanhoe St.—a combination punch and shear with 8 ft. gap, to punch a hole in the center of a plate 48 x ¾ in.

Ohio, Cleveland—J. Rutkowski, 7001 Polonia Ave.—motor driven air hammer.

Ohio, Cleveland—The Smith Foundry and Machine Co., c/o E. McGeorge, Arch., 1900 Euclid Ave.—crane, core oven and presses.

Ohio, Mansfield—The Altman & Taylor Co.—turbine blower.

Ohio, Toledo—The Lewis Steel Products Co.—triple purpose furnace, tool room grinder, milling machine, 16 in. drill press and a 16 in. shaper.

Wis., Milwaukee—The Milwaukee Forge and Machine Co., 340 Oklahoma Ave.—lathes, drills and bench tools.

Minn., Minneapolis—The Diamond Iron Works, 2nd St. and 18th Ave., N.—timber planer and jointer for handling sheets 8 in. thick and 24 in. wide.

Mo., St. Joseph—The St. Joseph Public Elevator Co., Corby Bldg.—drying machines.

Mo., St. Louis—G. Angelich, Arco Bakery, Broadway and Locust St.—$50,000 worth new machinery and equipment.

Mo., St. Louis—W. Serdt Bakery Co., 3155 Cherokee St.—$2000 worth machinery and equipment, including boilers and ovens.

Okla., Oklahoma—The J. B. Klein Iron and Foundry Co.—One 5 to 7½ ton, 45 to 50 ft. span electric crane and one 3½ to 5 ton, 35 to 40 ft. span electric crane, each to be 220 v., 3 ph., 60 cy., 3 motor.

Metal Working

NEW ENGLAND STATES

Conn., Bridgeport—The Columbia Grafanola Co., Barnum St., plans to build one 5 story and one 6 story factory on Barnum St. and Howard Ave. Estimated cost, $750,000 and $1,000,000.

Conn., Bridgeport—A. F. Crotty, 385 William St., plans to build a 1 story, 50 x 150 ft. garage. Estimated cost, $25,000.

Conn., Bristol—The New Departure Manufacturing Co., 269 North Main St., manufacturer of bells, has awarded the contract for the construction of a plant, to include two 3 story, 82 x 302 ft. and two 1 story, 67 x 312 ft. buildings. Estimated cost, $1,500,000. Noted May 1.

Conn., New Britain—The New Britain Machine Co., 140 Chestnut St., manufacturer of automatic and woodworking machinery, has had plans prepared by M. J. Unkelbach, Archt., 162 Main St., for the construction of a 1 story, 32 x 320 ft. factory with 40 x 70 ft. well. Estimated cost, $40,000.

Conn., West Haven (New Haven P. O.)—The New Haven Machine Co., 179 Milford Turnpike, Allington, has awarded the contract for the construction of a 1 story, 60 x 200 ft. factory on Orange Ave., here. Estimated cost, $35,000.

Mass., Boston—N. Berenson has awarded the contract for the construction of a 2 story, 125 x 242 ft. garage and storage plant on Brighton Ave. Estimated cost, $250,000.

Mass., Boston—The Rivett Lathe and Grinder Co., Newton St., has awarded the contract for the construction of a 3 story, 60 x 200 ft. factory, on Brook St. Estimated cost, $200,000.

Mass., Newton Upper Falls—The Saco Lowell Shops, Oak St., manufacturer of cotton machinery, has awarded the contract for the construction of a 1 story, 160 x 200 ft. factory. Estimated cost, $90,000.

Mass., Worcester—The Livingston Motor Co., 109 Grafton St., has had plans prepared for the construction of a 3 story, 80 x 250 ft. sales, service and assembling plant, on Shrewsbury St. Estimated cost, $150,000.

R. I., Providence—The Franklin Machine Co., 189 Charles St., has awarded the contract for the erection of a 1 story, 61 x 81 ft. foundry. Estimated cost, $25,000.

MIDDLE ATLANTIC STATES

Md., Cardiff—R. Roberts & Son plan to rebuild farm machinery plant which was destroyed by fire. Estimated cost, $10,000.

N. Y., Albany—J. A. La Porte, 9 St. Joseph Terrace, has awarded the contract for the construction of a 2 story, 60 x 200 ft. garage on Sheridan Ave., near Lake St. Estimated cost, $60,000.

N. Y., Buffalo—C. J. Irwin, Ellicott Sq., is having plans prepared by F. J. and W. A. Kidd, arch., 284 Delaware Ave., for a 4 story, 90 x 100 ft. garage, to be erected on Swan St. Estimated cost, $75,000.

N. Y., New York (Borough of Bronx)—J. Bothwell, 30 West 130th St., is having plans prepared by E. Wilbur, arch., 507 5th Ave., for a 1 story, 100 x 115 ft. garage, to be erected on Sherman Ave. and 162nd St. Estimated cost, $35,000.

N. Y., New York (Borough of Manhattan)—The Le Roy Holding Co., 214 Fulton St., will alter their 1 and 2 story machine shop, at 129-137 Leroy St. Estimated cost, $10,000.

Penn., Philadelphia—H. Ketcham, 1160 North 3rd St., has awarded the contract for the construction of a 1 and 3 story, 100 x 150 ft., 30 x 36 ft. and 16 x 40 ft. garage, office and lumber shed, on Girard and 3rd St. Estimated cost, $22,000.

Penn., Shamokin—A. H. Kirchner will soon award the contract for the erection of a 1 story, 50 x 90 ft. addition to garage. Estimated cost, $10,000. W. H. Lee, 32 South 17th St., Arch.

MIDDLE WEST

Ill., Chicago—The Fitzsimmons Steel and Iron Co. West 37th St. and Racine Ave., has purchased a site on 33d St. and Kedzie Ave. and plans to build a plant, for the manufacture of cold-drawn steel shapes. Estimated cost, $300,000.

Ill., Chicago—D. S. Klafter, Arch., 64 West Randolph St., will soon award the contract for the construction of a 1 story, 125 x 200 ft. foundry, a 2 story, 30 x 85 ft. warehouse and a 2 story, 60 x 65 ft. office, for H. Kramer & Co. (metal refiners), 1330 West 21st St. Estimated cost, $165,000.

Ind., Indianapolis—The Millholland Machine and Manufacturing Co., West 23rd and Belt Ry., has awarded the contract for the construction of a 1 story, 100 x 200 ft. machine shop. Estimated cost, $100,000.

Ind., Richmond—The National Automatic Tool Co., 7th and South North Sts., has awarded the contract for the construction of a 1 story, 200 x 250 ft. factory. Estimated cost, $140,000.

Mich., Detroit—Kennedy Bros., 503 Sun Bldg., plans to build a 2 story, 86 x 167 ft. service station and salesroom on Cass Ave. and Putnam St.

Mich., Detroit—The Sewell Cushion Wheel Co., 1296 Gratiot Ave., has purchased a site on Harper Ave and Detroit Terminal Ry., and plans to build a factory for the manufacture of automobile wheels. Estimated cost, $100,000.

Mich., Detroit—F. J. Whitney, 1443 Grand River Ave., has purchased a site on Franklin St. and plans to build a 2 story, 150 x 300 ft. garage.

Mich., Flint—City Water Dept. is having plans prepared by Van Leyen, Schilling & Krough, Engrs., 1115 Union Trust Bldg., for 1 story, 40 x 106 ft. garage, to be erected on Saginaw St. Estimated cost, $15,000.

Mich., Saginaw—The Michigan Crankshaft Co. has awarded the contract for the construction of a 1 story, 160 x 690 ft. factory on Genessee Ave. near the Pere Marquette Ry. Estimated cost, $600,000.